APPLIED Hydraulics & Pneumatics

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NEW 1959 JIC hydraulic standards complete in this issue

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Packing Materials

see contents page 3

THE MAGAZINE OF FLUID POWER

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CONNECTION
or
DISCONNECTION

with
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SHUT-OFF

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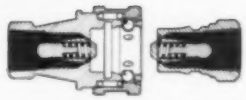

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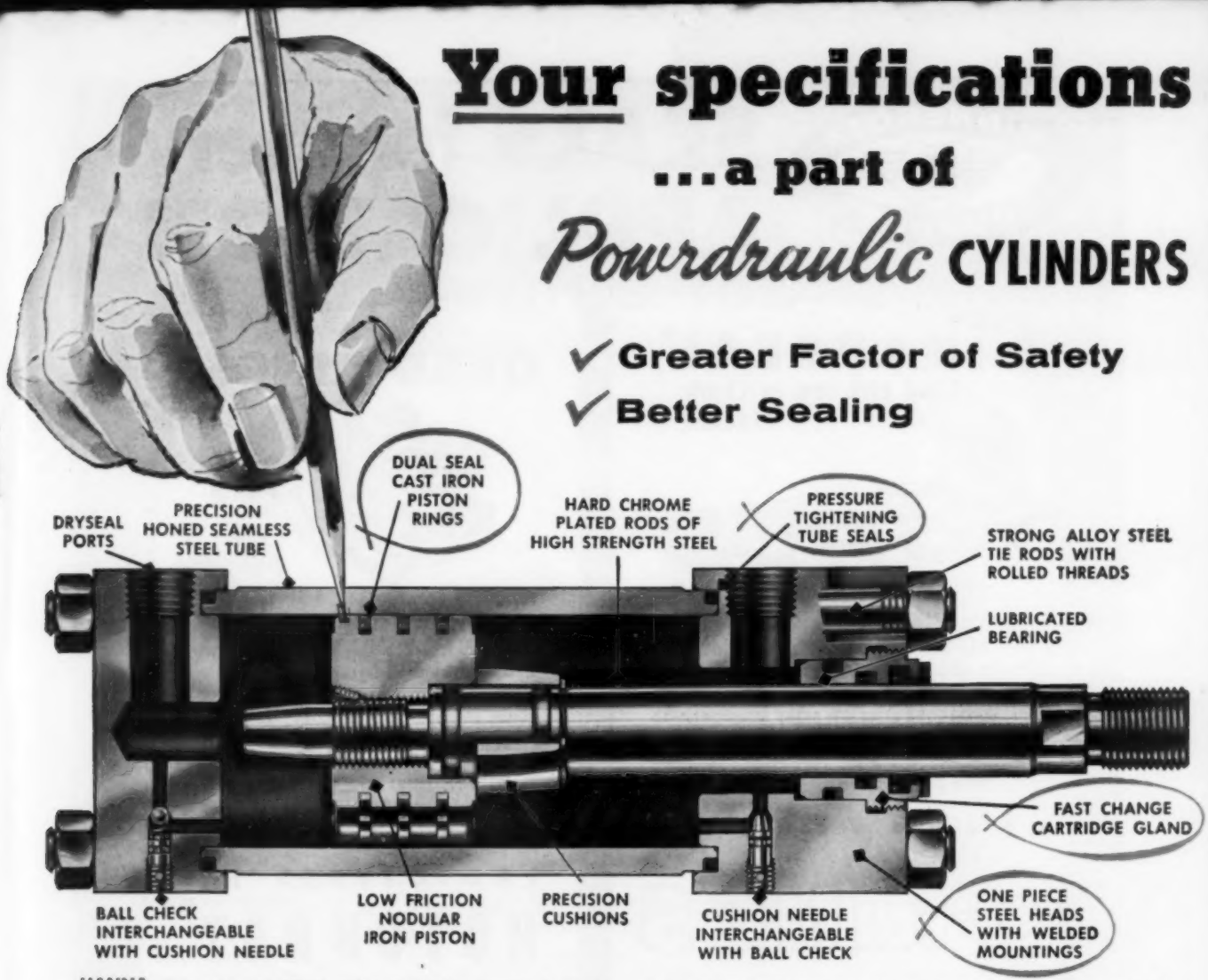
DRYSEAL PORTS
PRECISION HONED SEAMLESS STEEL TUBE
DUAL SEAL CAST IRON PISTON RINGS
HARD CHROME PLATED RODS OF HIGH STRENGTH STEEL
PRESSURE TIGHTENING TUBE SEALS
STRONG ALLOY STEEL TIE RODS WITH ROLLED THREADS
LUBRICATED BEARING
FAST CHANGE CARTRIDGE GLAND
ONE PIECE STEEL HEADS WITH WELDED MOUNTINGS
BALL CHECK INTERCHANGEABLE WITH CUSHION NEEDLE
LOW FRICTION NODULAR IRON PISTON
PRECISION CUSHIONS
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FAST CHANGE CARTRIDGE GLAND equipped with a leak proof, low friction rod seal forms a tight seal from zero to maximum pressure. Built in rod wiper removes dirt and particles from piston rod as the rod moves "in" and serves as another hydraulic seal to wipe the rod dry on the "out" stroke. You can select either the standard gland or the optional, multiple lip, spring loaded seal. The optional gland is interchangeable and is available with synthetic rubber or Teflon* Vee packing.

ONE PIECE STEEL HEADS WITH WELDED MOUNTINGS are much stronger than conventional bolted construction and assure squareness of mountings. All mountings are designed to carry maximum cylinder loads with a generous safety margin.

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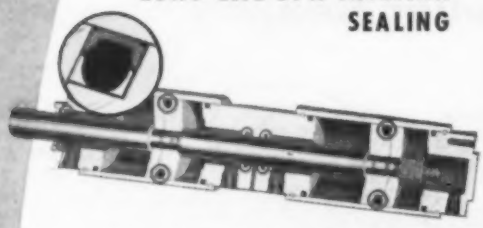

The Kapseal is a Teflon "boot" which was designed to combine with a standard O-ring for specialized sealing applications. It has low breakout friction after long periods on standby, and gives outstanding service on long running, low friction applications.

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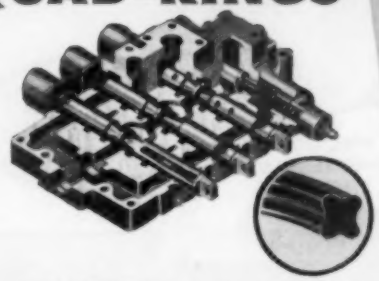
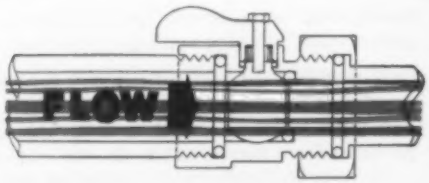


The QUAD RING, exclusive with Minnesota Rubber, has been the answer on sealing jobs where other seals were unsatisfactory. Its four contoured lips completely eliminate spiral twist failure, and it seals from 0 to 1500 PSI.

O-RINGS



Minnesota Rubber injection molded O-rings give better service because their dense composition helps them resist wear and abrasion. They are also flash free to give tops in sealing on applications where O-rings are used.

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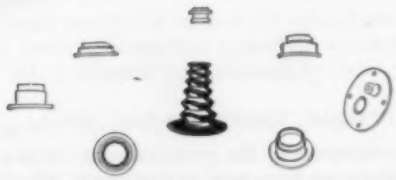

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APPLIED
Hydraulics & Pneumatics

JULY 1959 THE MAGAZINE OF FLUID POWER VOLUME 12/NUMBER 7

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NFPA Adopts List of Cylinder Bore and Rod Sizes—"Hula-Head" is a Cutting Sensation—Feed Mechanism for Accuracy, High Production—Leak-Resistant Oil Cuts Loss 35%—Briefs from Britain—Fluid Power Highlights at Coal Show—Pressure Vessel Gets Tough Tests—20 Papers Accepted for Annual NCIH Meeting—Clark Equipment Forms Hydraulic Division

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. . . Fluid Power news

REPORT No. 11,705 HOIST—TRAVERSE—CABLE REEL DRIVES

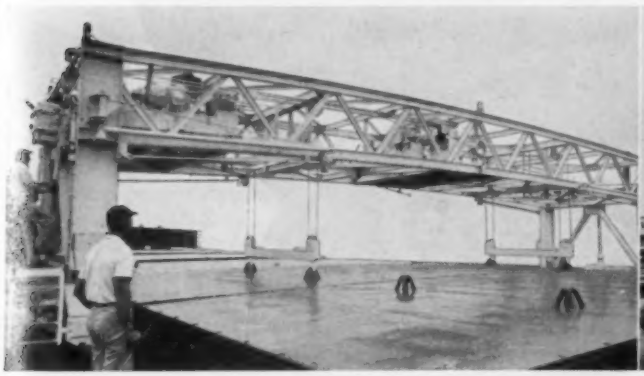
From Oilgear Application-Engineering Files

HOW OILGEAR DRIVES SPEED HANDLING OF ORE BOAT'S "KING SIZE" HATCH COVERS

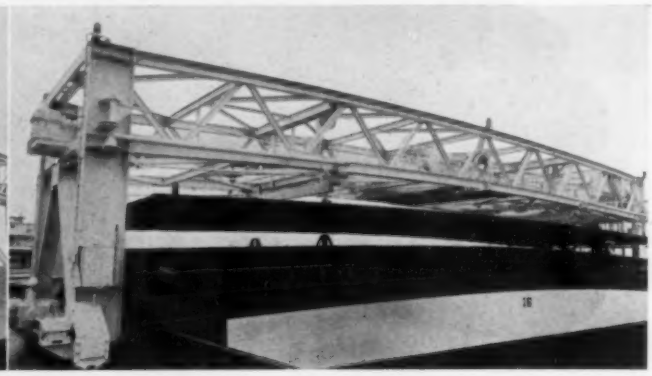
OPERATOR: *M. A. Hanna Company . . . National Steel Corp., Owner. (Builder) — (The American Ship Building Co.)*

DATA: To speed loading and unloading, avoid damage to hatch coamings, reduce hold cleanup time . . . the 710-ft Great Lakes ore carrier *George M. Humphrey* was equipped with 17 x 54-ft hatch openings rather than standard 11 x 46-ft hatches. To lift, carry, and stack 19 of these larger, heavier hatch covers, a 59-ft span traversing crane weighing 24 tons was specially designed.

Crane Drive Requirements: 1. Traverse a 3° slope while lift-loading 30,000 lb (weight of hatch cover plus 5,000-lb ice allowance). 2. Lifting-lowering speed — infinitely variable, 0 to 20 ft/min. 3. Traverse speed — infinitely variable, 0 to 120 ft/min. 4. A separate, constant-torque cable reel drive to automatically "pay off" and retrieve crane power supply cable during 500-ft hatch deck traverse. 5. Smooth, dependable operation, precise speed control, controlled acceleration and deceleration, dynamic braking during continuous exposure to the elements, occasional exposure to iron ore and coal dust, over an 80° range of temperature, with minimum maintenance and power consumption.



Control platform end of the double-truss hatch crane on ore carrier George M. Humphrey. Oilgear "Power-Pak" position is indicated. Oilgear Fluid Power hoist drive motor (F) can be seen in the center of the 59-ft span.

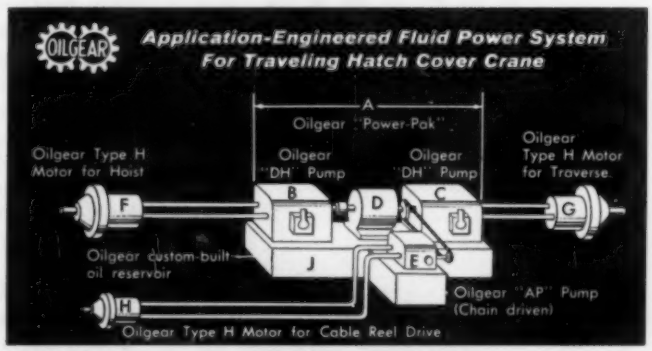


17-ft x 54-ft hatch covers being stacked in the 19-ft space over the hold bulkheads. Over-all crane height is 15 ft above the deck. Clearance is sufficient to stack 7 hatch covers. Oilgear Fluid Power traverse drive is visible to left.

SOLUTION: Three separate Oilgear "Any-Speed" Drives . . . one for the hoist, one for traversing, one for the automatic power cable reel. Controlled *Fluid Power* for each drive is generated by a single Oilgear custom-built *"Power-Pak"* (A). The *"Power-Pak"* consists of: 1 Two Oilgear type "DH," two-way, variable displacement pumps with integral, hydraulic servo-motor lever controls (B & C). Pumps are direct-connected to opposite ends of a double-end, constant-speed, AC motor (D). 2. An Oilgear type "AP" variable displacement pump with automatic, constant-torque control (E), which is chain-driven from motor (D). 3. A fully equipped oil reservoir (J), has all above equipment mounted and coupled for easy, single-unit installation on the hatch crane.

OPERATION: Oilgear type "DH" variable displacement pumps (B & C) supply controlled *Fluid Power* to Oilgear type "H" constant displacement motors (F & G). Motor "G" drives crane traverse wheels through reduction gears. Motor "F" powers the hoist. Integral pump controls provide both dynamic braking and acceleration and deceleration limitation to reduce peak loading. Chain-driven, Oilgear type "AP" variable displacement pump (E) with automatic, variable torque control supplies controlled *Fluid Power* to Oilgear type "H" motor (H) for the automatic, constant-torque power cable reel drive. Oilgear custom-built oil reservoir (J) serves as a base for the above pumps and controls completely mounted and coupled to the customer's electric motor (D). Oilgear single-unit *"Power-Paks"* are shipped complete — ready for installation . . . eliminate costly hand-fitted assemblies, unnecessary engineering, excessive power loss, leaks, repetitive malfunctioning, and "Christmas tree" appearance. Uses simple across-the-line starter — not complex DC controls.

USER REPORTS — *operation is fast, quiet, smooth . . . all hatch covers have been removed and stacked in a record time of 28 minutes.* Dependability and low maintenance are illustrated by the statement — *all equipment in excellent condition* — quoted from a routine service check report dated May, 1958 — after four years of operation . . . further confirmation of the statement heard in all industry — *"for the lowest cost per year . . . it's Oilgear!"*



In addition to Oilgear Hatch Crane drives, the *"Humphrey"* is equipped with a C. H. Wheeler electrohydraulic steering gear powered by two Oilgear type "DH-60" two-way, variable displacement pumps with integral servo controls. A few of the other Oilgear-equipped Great Lakes ships are the *Ernest T. Wier; Wilfred Sykes;* the *"Fords" — William Clay, Henry II, and Benson; E. J. Block;* tanker *Chicago Socony;* the *"Forts" — Henry,* and *York* . . . plus many other vessels of all descriptions operated on the navigable rivers, lakes, harbors, and oceans of the world. Other Oilgear marine applications include mobile drilling barges, elevators, catapults, hoists, winches, capstans, steering gear, large valve controls, and numerous lock and dam gate installations.

For practical solutions to YOUR linear or rotary drive and control problems, call the factory-trained Oilgear Application-Engineer in your vicinity. Or write, stating your specific requirements, directly to . . .

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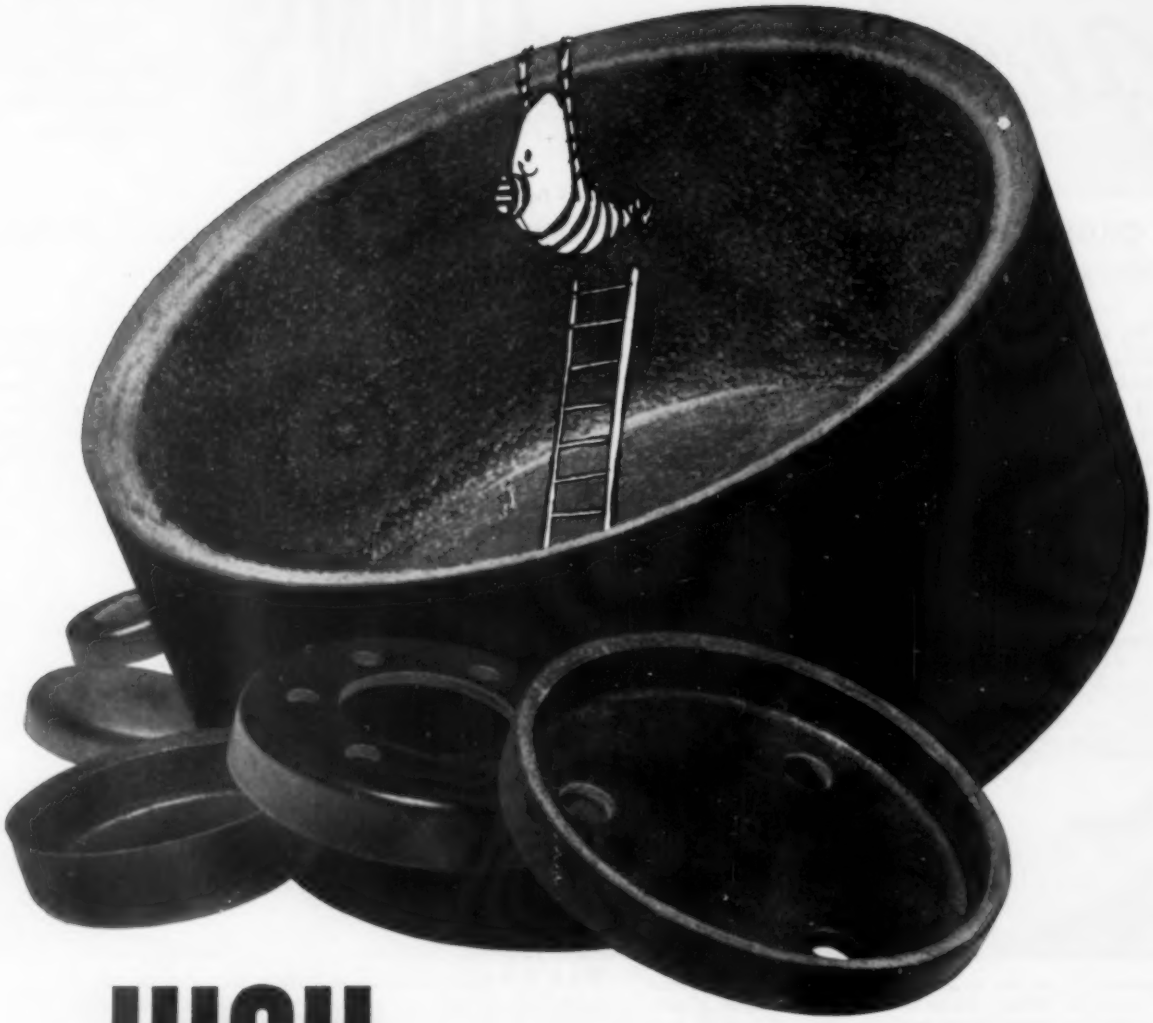

HIGH WALLED ?

How long since you have re-evaluated the wall height on your cup packings? Frequently IPC encounters "prints" which call for excessive wall height . . . *and* this extra depth can cause headaches.

Unnecessary wall height can only add to friction and make your cups run "hotter" . . . Torque increases . . . Toe-in is enhanced. Unless there is some unusual factor involved, IPC can recommend a more functional design without these built-in hazards.

Elaborate hide selection combined with IPC "custom treats" and IPC's square shouldered design mean your leather packings and oil seals are started "right". For the finishing touch, IPC offers the last word in quality controlled manufacture.

Let us analyze your leather packings. Perhaps we can tailor a design that will fit your application perfectly.

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PRECISION MOLDING
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. . . for your application

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P5

NEW PRODUCTS

NEW ANCHOR WELD TYPE FITTINGS FOR PIPE OR TUBING

The progress in hydraulic equipment design and the increasing complexity of this equipment has started a trend toward the use of pipe or tubing assemblies for the transmission of hydraulic fluid, with flexible hose assemblies used to connect the pipe or tubing to valves, pumps, etc. The use of pipe threads and pipe fittings in connecting these assemblies has created difficult piping problems.

To meet the specific need for a more satisfactory and convenient method for connecting pipe or tubing assemblies to hydraulic equipment, Anchor is introducing a new line of 3000 psi Weld Type Fittings, designed to be used with Anchor patented SAE 4-Bolt, Split-Flange Clamp Halves and "O" Ring, Flanged Head Couplings. With their use, pipe or tube assemblies can be made from a single length of pipe or tubing, bent to conform to any desired shape. Made with a socket type fitting for welding onto the end of pipe or tube, and a saddle type for welding onto the pipe anywhere along its length, an assembly of any shape or desired number of openings can be produced. Also available are 90° Elbow Fittings and Tee Fittings with SAE 4-Bolt connections for joining 2 or 3 hose assemblies.

Anchor will furnish fittings for their customers' pipe assemblies, or will manufacture the assembly to the customer's specifications.

A supplement to Anchor Catalog No. 402, with complete specifications of the new Weld Type Fittings, is available on request from Anchor Coupling Co. Inc., 318 No. Fourth St., Libertyville, Ill.

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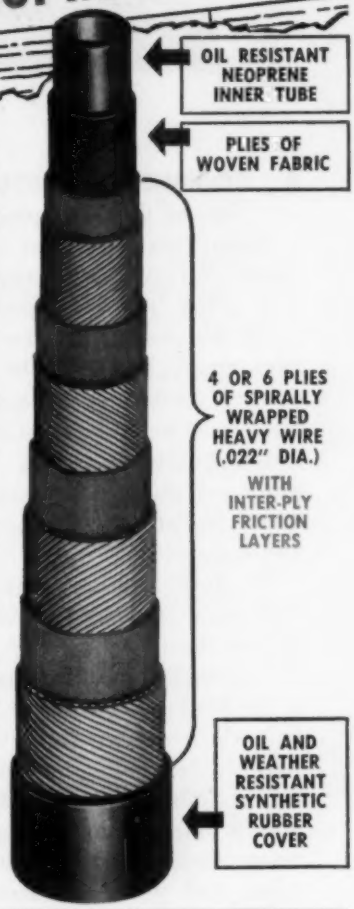
EXTRA!

HIGHER HYDRAULIC PRESSURES NOW FEASIBLE WITH NEW ANCHOR "SUPER-SPIRAL" HOSE


OIL RESISTANT NEOPRENE INNER TUBE
PLIES OF WOVEN FABRIC
4 OR 6 PLIES OF SPIRALLY WRAPPED HEAVY WIRE (.022" DIA.)
WITH INTER-PLY FRICTION LAYERS
OIL AND WEATHER RESISTANT SYNTHETIC RUBBER COVER

Designers of hydraulic equipment wishing to increase pressures have been hampered by the lack of dependable, extra high pressure hose. With the introduction of Anchor's "SUPER-SPIRAL" Hose, these limitations have been removed. This hose is already finding wide usage in the replacement of old style braid hose to obtain greatly extended service life.

This hose, available in sizes from 3/16" to 1½" has either 4 or 6 plies of all spirally wound heavy wire reinforcement, with no crossed wires to fatigue, break and weaken hose.

It offers a completely new maximum pressure range for the hydraulic engineer,—opens up new horizons for the hydraulic designer.

- **4 or 6 Plies of Spirally Wound Wire Reinforcement**
- **Maximum Working Pressures from 12,500 psi (3/16" I.D.—6-Ply) to 2500 psi (1½" I.D.—4-Ply)**
- **Heavy Wire, .022" Dia., Reinforcement**
- **All Spirally Wound—No Braid, No Crossed Wires That Lead to Wire Fatigue**
- **Available with Any Anchor Pressed-On Couplings**

Andy Anchor says: You will find all descriptive details and specifications on Anchor's new "SUPER-SPIRAL" High Pressure Hose and the Couplings in a special data sheet now available on request.

I.D.	FOUR PLY		SIX PLY	
	MAX. WORK. PRES. (psi)	MIN. BURST. PRES. (psi)	MAX. WORK. PRES. (psi)	MIN. BURST. PRES. (psi)
3/16"	10,000	40,000	12,500	50,000
1/4"	8,750	35,000	11,250	45,000
3/8"	7,500	30,000	10,000	40,000
1/2"	6,250	25,000	7,500	30,000
3/4"	5,000	20,000	6,250	25,000
1"	4,000	16,000	5,000	20,000
1-1/4"	3,000	12,000	3,500	14,000
1-1/2"	2,500	10,000	3,000	12,000
*2"	2,000	8,000	2,500	10,000

*Under Development

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FLUID POWER LINES

about hydraulics & pneumatics

A COMMON LANGUAGE . . . One of the basic problems in international relations is language differences. Frenchmen can't talk to Germans, Americans don't converse with Russians. Even among people of the same country, there are language barriers because of location or vocation. Engineers develop standards as a common language for specifying and buying machines and components.

The Joint Industry Conference Hydraulic Standards, which are revised complete in this issue, have brought a common language to the fluid power industry. Symbols which are easy to draw, and indicate flow paths under different conditions in the system, have gone a long way in helping fluid power designers sketch out their ideas and get them across to other engineers. Rules for mounting pumps, designing reservoirs, installing packing have brought component manufacturer, machine builder, and user together with a common language to get the safest, cheapest, and highest performance equipment.

REPRINTS of the revised JIC Hydraulic Standards are available at the following prices:

Single copy	75¢
10 to 24 copies	60¢
25 to 49 copies	50¢
50 or more copies	40¢

Send your order to APPLIED HYDRAULICS & PNEUMATICS Magazine, 812 Huron Road, Cleveland 15, Ohio

ONES THAT WON'T LEAK . . . Every designer who specifies packings wishes he could call up his supplier and specify that *simple* requirement. But many factors must be considered to get the best packing for each application. Whether to use a U-ring, a set of V-rings, an O-ring, or a metal ring depends on pressure, frequency of cycling, fluid, temperature, surface smoothness, and other considerations. How to design the packing installation for highest effectiveness is a subject in itself.

Another area in which the designer should be familiar is materials. Synthetic rubbers, leathers, fluoro-elastomers all have special advantages for certain applications. Knowing these advantages will help you select one with the best chance of leakproof operation. Three articles in this issue discuss packing materials and what they can do. A special report by associate editor Sy Datz summarizes properties of materials used in packings for air and oil systems.

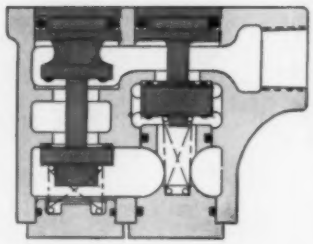
Teflon is the subject of an article by duPont's L. H. Gillespie. Here's a very complete treatment of Teflon's action and performance as a material for lip seals like cups and V-rings, O-rings, and other special shapes.

Third article in this month's packing material package is Richard Freedman's *What You Should Know About O-rings* in the Aircraft Section. A senior design engineer in Convair's hydraulic group, Freedman discusses the question of when does a seep become a leak?

. . . and half a dozen trimetzoethyleneorthohybrid V-rings.

a basic **Ross**
valve building block

4-way inline mounted valve body



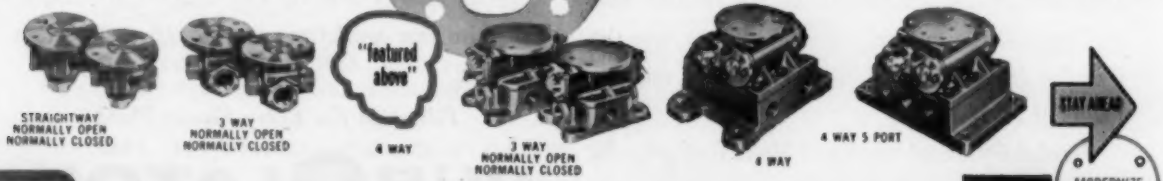
- **Compact—saves space**
- **Ross quality**
- **Costs much less than base mounted 4-way**

Lots of designers use this valve where they must save space. It was designed specifically for compactness! Others use it to save money *without sacrificing* quality—when J.I.C. allows the usage of an inline valve, it meets J.I.C. specs. It's a unit of the Ross Skyline series which features modular construction, so it can be actuated with any Skyline series head. Ross poppet construction means pressure assists the seal, and short poppet travel gives faster response. On most applications it outlives the machine—and frequently doesn't even require maintenance. Write for Bulletin 321.

* WHITEMODEL SPOOL SOLENOID
* GOLDMODEL OIL-IMMERSED SOLENOID
* SILVERMODEL JIC SPOOL SOLENOID
GREENMODEL DOUBLE SOLENOID MOMENTARY
BLUEMODEL AIR OPERATED
BLUEMODEL AIR-OPERATED MOMENTARY ADAPTOR
BLUEMODEL AIR-OPERATED TIMED IN
BLUEMODEL AIR-OPERATED TIMED-OUT
*THIS AIR INDEX ADAPTOR CONVERTS THESE HEADS TO MOMENTARY ACTION

"every head meets every body at this gasket"

ALL SKYLINE HEADS AND BODIES ARE BUILDING BLOCKS TO GIVE YOU MANY VALVES FROM A FEW HEADS AND BODIES



ROSS OPERATING VALVE COMPANY
105 EAST GOLDEN GATE AVE. • DETROIT 3, MICH.

Circle **120** on Time-Saver Card

PUROLATOR FILTERS FOR THE PROTECTION OF HYDRAULIC CIRCUITS

G-200M Aircraft Restrictor Filter two-way for hydraulic oil systems metal element

PR 301 ½ GPM line type hydraulic oil filter Micronic element

PR 362 3 CFM in-line vent type Micronic element

G 200 series In-line two-way restrictor filter Metal element, internal connections

PR 312 12 GPM line type filter Micronic element

PR 412-8 12 GPM line type filter Military approval

G-187 3 GPM in-line hydraulic oil filter Metal element

P 32-28 Low pressure, high flow hydraulic oil filter

Effective filtration is essential for optimum performance in hydraulic circuits. To keep a system clean and functioning properly, it is important that the filter be designed specifically to meet the requirements of the job.

Purolator's complete line of filters for hydraulic systems includes models for every set of operating conditions likely to be encountered. A few are shown here; there are many more standard models from which to choose. If your application requires a special filter, Purolator will design and build it. Let Purolator work on your toughest filtration problem.

Filtration For Every Known Fluid

PUROLATOR

PRODUCTS, INC.

Rahway, New Jersey and Toronto, Ontario, Canada

DYNAMIC DIFFERENCE
in hydraulic performance

Webster
DIRECTIONAL CONTROL VALVES

Combines to culvert cleaners — anywhere one, two or more hydraulic applications are handled at one time... *the difference is dynamically apparent when Webster is on the job!* Versatile! Parallel design permits control of up to 6 independent circuits. Range! Operating pressures to 2000 psi — shock pressures to 5000 psi. Lowest back pressure. Compact! Smallest size for rating. Three sizes — single spool type in 20 gpm capacity, parallel stacked in 20 and 40 gpm capacities.

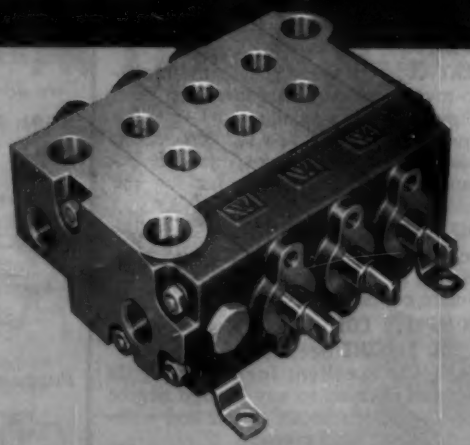
You find Webster Directional Control Valves on leading agricultural, road building and industrial machines. Chances are there's a size and model ideally suited for your product — for the dynamic difference that pays!

OIL HYDRAULICS DIVISION

WEBSTER ELECTRIC

RACINE · WIS

our 50th year



DESIGNED FOR PEAK PERFORMANCE

- Alloy steel spools — heat-treated, precision-ground.
- Fully balanced at all pressures.
- Stack valves have throttling grooves in spools for smooth, gradual flow.
- Inlet and outlet connections can be made to the same end of the valve assembly to simplify hook up.
- Alternate porting positions provided for flexibility in application.

Call the man from Webster

... he's one of a staff of engineers, specially trained in hydraulic application. He can help you solve special problems when hydraulics become a part of your design!

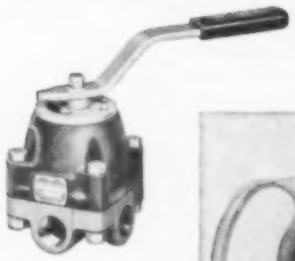
BULLETIN HY11 gives complete performance and installation data.

For High Pressure (to 6000 P.S.I.)

MANUAL WATER VALVES

that last

Specify "SHEAR-SEAL" design



4-Way, Manipulator, Dual pressure and Shut-off Valves from ¼ to 1½" N.P.T.

Note the mirrorlike sealing surfaces on this Dual Pressure Valve rotor after 4 years of service.

On extrusion presses, die casting machines, rubber and plastic molding presses and on blowout preventers, they have performed without maintenance longer than any other type of valve.

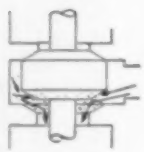
This LONG, MAINTENANCE-FREE SERVICE is possible because the metal-to-metal sealing surfaces are self-aligning and actually improve with use through continued lapping action. Sealing qualities do not diminish because a spring compensates for the wear.

DIRT CANNOT SCORE SEALS because flow is through "Shear-Seals," sealing surfaces remain in constant intimate contact.

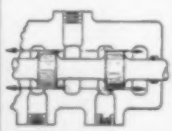
COMPLETE CONTROL OF YOUR CIRCUIT because "Shear-Seal" design is excellent for throttling. It permits opening to any desired degree of flow with smooth action and without fighting fluid pressure.

The "Shear-Seal" action eliminates line surges and the round tubular flow passages provide more flow and velocity capacity (up to 60 ft. per sec.) because they are unobstructed by spools or poppets.

This is why we don't use **SPOOL OR POPPET DESIGN**



Poppets score



Spools leak

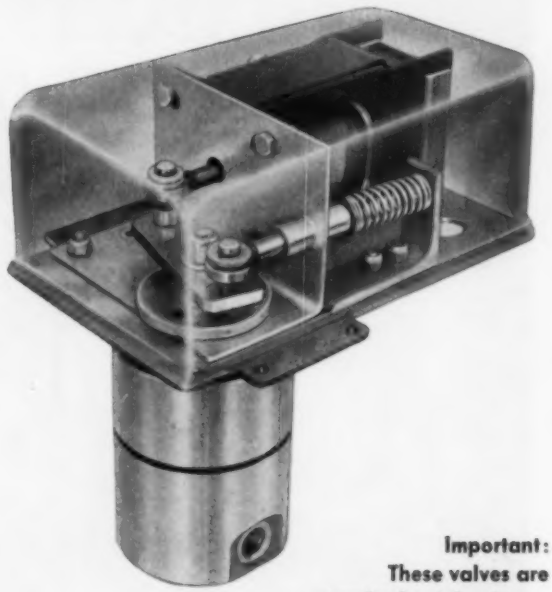
Write for Catalog V-59-60

CONTROL VALVE DIVISION

Barksdale valves

5125 ALCOA AVENUE • LOS ANGELES 58 • CALIFORNIA

10,000 P.S.I. SOLENOID VALVES



Important: These valves are standard catalog items.

● They are available for immediate delivery (in stock) at standard valve prices, for a service which generally requires costly (made-to-order) special valves.

● Shut off and 4-way valves in ¼, ⅜ and ½ inch port sizes are rated for 10,000 P.S.I. liquid or gases. They will withstand surges of up to 15,000 P.S.I. without damage to the valves' sealing qualities (designed for a burst pressure of 30,000 P.S.I.).
Solenoids are available for 115, 230 and 460 volt A.C. operation.

● Long maintenance-free service is achieved through the leak-proof "Shear-Seal" design. Optically flat metal to metal sealing surfaces (of the self-aligning sealing rings and the mating rotor face) are protected by staying in constant intimate contact: flow is always through the center of the "Shear-Seals," never across sealing surfaces. Sealing qualities actually improve as the seals lap themselves to a more perfect fit with each valve operation. There is no external shaft leakage because the pressure is confined to the flow passages.

For complete data write for catalog S-10000.

CONTROL VALVE DIVISION

Barksdale valves

5125 ALCOA AVENUE • LOS ANGELES 58 • CALIFORNIA

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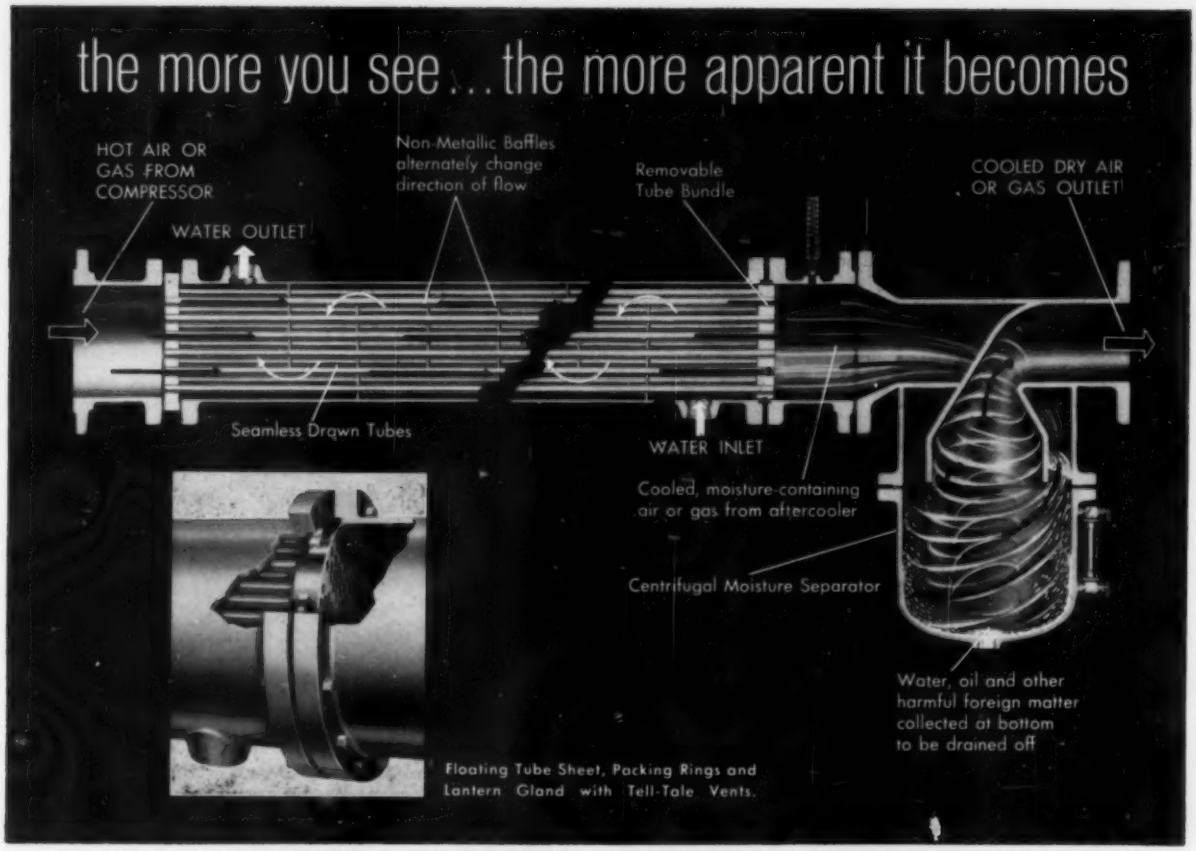
Circle **16** on Time-Saver Card


the more you see... the more apparent it becomes
HOT AIR OR GAS FROM COMPRESSOR
WATER OUTLET
Non-Metallic Baffles alternately change direction of flow
Removable Tube Bundle
COOLED DRY AIR OR GAS OUTLET
Seamless Drawn Tubes
WATER INLET
Cooled, moisture-containing air or gas from aftercooler
Centrifugal Moisture Separator
Water, oil and other harmful foreign matter collected at bottom to be drained off
Floating Tube Sheet, Packing Rings and Lantern Gland with Tell-Tale Vents.

NEW ROSS PIPELINE AFTERCOOLERS

are today's most effective means of cooling and drying compressed air

Here, cut away for your inspection, is the new **Ross Type A-100** Pipeline Aftercooler . . . the "inside story" with everything revealed.

Note how the air in the tubes flows counter to the water in the shell so that the coldest (incoming) water serves the coldest (outgoing) air. Note, too, how the air is baffled into a swirling eddy within the moisture separator to force (centrifugally) water and all other entrainment from the line.

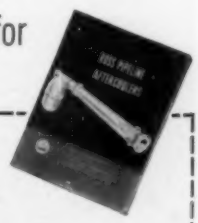
Examine every feature! The more you see, the more apparent it becomes: *This new aftercooler is the most efficient unit ever built for air compressor service.*

Equally important is the fact that fully standardized parts are utilized to eliminate costly "specials" in both engineering and fabrication. You save in every way.

Compact and easy to install, a Ross A-100 can be readily fitted into any compressed air system. There are 54 models to choose from, with capacities ranging from 0 to 36,000 scfm at operating pressures up to 150 psig for single or two stage compression.

Why not see all there is to see? New Bulletin 302.6K1 contains the complete, illustrated story as well as specifications. Send the coupon for your copy now.

Mail this coupon for new Bulletin



TO

American-Standard*
Industrial Division
Detroit 32, Mich.

SEND your new Bulletin 302.6K1 describing Ross Type A-100 Pipeline Aftercoolers.

NAME _____

TITLE _____

COMPANY _____

ADDRESS _____

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AH759

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AMERICAN-Standard
INDUSTRIAL DIVISION

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Eastman offers INDUSTRIAL SWIVEL CONNECTOR

to eliminate hydraulic hose failure under severe flexing

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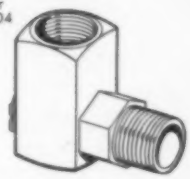
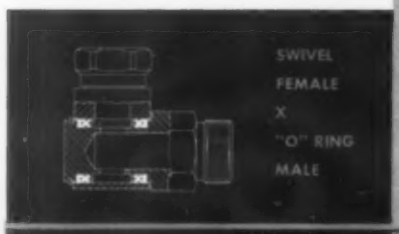
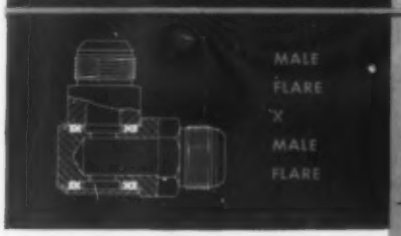
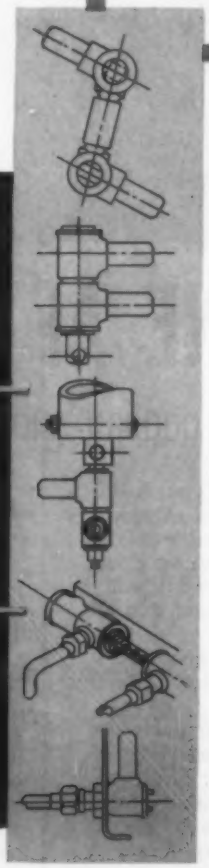








If you have been designing "around" metal swivel joints because of high cost, EASTMAN now offers an economical swivel connector for industrial use—precision engineered to assure adequate freedom of motion—proved under the most rigid government requirements.

Unique design assures "balanced" flow of hydraulic fluid at required pressure—at any angle. Fluid pressure is also balanced by a ***double seal*** assembly at each end of stem. Pressure-Balance assures equal internal pressure, causing the body to float about the stem, free of end load and friction.

Eastman Swivel connectors will make your flexing installations the most reliable link in your Hydraulic Assembly.

APPLICATIONS:
For use on Cranes, Loaders, Earth Moving Equipment, Hydraulic Presses, Shears, etc.—wherever unusual flexing and exposure may shorten hose life or cause premature failure and frequent replacement.

ECONOMY:
Permits use of shorter hose lengths since less hose allowance is needed for complete extension. Shorter lengths of longer lasting, multiple spiral wire high pressure hose may be used, since Swivel Connector absorbs flexing motion.

ADAPTABILITY:
Body of Connector available with any combination of ends. Now available in types and sizes shown at left. Various combinations of stems can be interchanged with any body style.

WRITE, WIRE or CALL about Eastman Swivel Connector Opportunities in Your Line.

STANDARD SIZES AND COMBINATIONS AVAILABLE

•

LOW TORQUE—Freedom from friction, even under high pressure.

WIDE RANGE—Operating pressures up to 5000 PSI. Trouble-free operation through wide temperature range.

ROTATION—Full 360° for all manifolds.

SIZES—Steel, plated for corrosion protection—½" thru 1½".

Eastman
first in the field
MANUFACTURING COMPANY
Dept. AH-7, MANITOWOC, WISCONSIN

SAFEGUARDING AMERICA'S LIFELINES OF MOBILE POWER

LETTERS
to the editor

Address your letters to: Editor, APPLIED HYDRAULICS & PNEUMATICS MAGAZINE, 812 Huron Rd., Cleveland 15, Ohio.

Investigating new process of hydroforming

TO THE EDITOR:

We are investigating a new process involving hydraulics and would appreciate your aid in locating some sources with whom we may work on our project. The name of the process is hydroforming. A piece of tubing, 15 to 24" long, is to be expanded to form a stepped or telescoped appearing tube. To do this, we plan to use hydraulics so the tubing becomes an integral part of the hydraulic system. Fluid under pressure would be applied to the inside of the tube to expand the tubing into a die of the desired shape. Please send us some information on companies working along these lines.

LE ROY F. ENGEL
Engineer
Village Blacksmith Division
General Metals Corporation
Watertown, Wis.

We saw a similar operation at General Electric Co. in Pittsfield, Mass. We have information for an article, which will appear in APPLIED HYDRAULICS & PNEUMATICS later this year.

Requests information on hydraulic motors

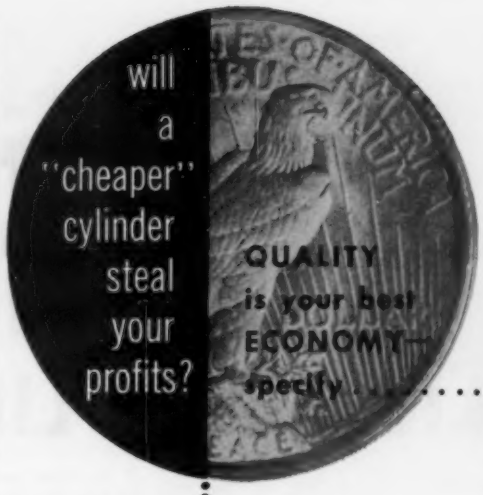
TO THE EDITOR:

I am an instructor in farm mechanization at our school. Lately I have been teaching our students about hydraulic motors. I would appreciate your sending me literature concerning the practical application of hydraulic motors, and information on conversion of a hydraulic gear pump to a hydraulic motor, HP calculations, formulas, gpm, rpm, etc.

ALEXANDER EPHRAT
Jordan Valley Agro-Tech
Afikim, Israel

You will find our FLUID POWER DIRECTORY *an excellent source of basic information. It includes the calculation information you want.*

Continued on page 18



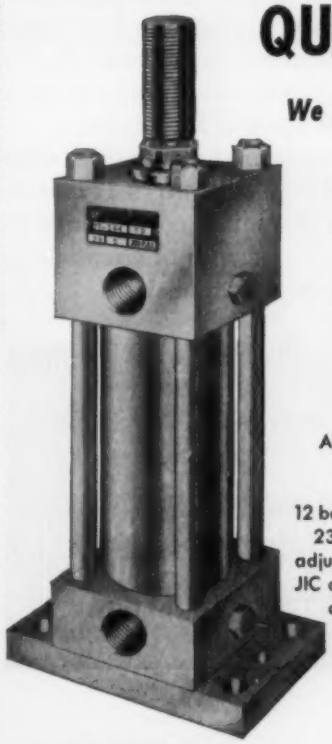
BOOST Production • STOP Down-Time Losses with SP CYLINDERS

Last Longer

Compact, Fit Anywhere

PROMPT Off-the-shelf DELIVERY Reduces your inventory, saves money

YOU can prove our QUALITY!



We invite you to test our air and hydraulic cylinders against any other! Our confidence is in our quality.

S-P COMPLETE LINE: Air: 200 psi; Hydraulic: 2000 psi (operating), 3000 psi (non-shock); 12 bore sizes—1½" to 14"; 23 mounting types; fully adjustable cushions; 100% JIC and automotive standards; interchangeable.

AA-8903

FREE Engineering Service Representatives in principal cities Phone or Write Today

Find us fast in the 'Yellow Pages'

PROVEN QUALITY SP CYLINDERS • CHUCKS SPEED • PERFORMANCE

THE S-P MANUFACTURING CORP.
30201 Aurora Rd. • Solon, Ohio

A BASSETT COMPANY • IN GREATER CLEVELAND • ESTABLISHED 1916

Non-Rotating and Rotating AIR and HYDRAULIC CYLINDERS • VALVES
POWER CHUCKS • COLLET and DRILL PRESS CHUCKS • ACCESSORIES

Circle **121** *on Time-Saver Card*

Join the Big Switch to Republic ELECTRUNITE HYDRAULIC FLUID LINE TUBING

Get more tube per dollar...

Join the hundreds of manufacturers using millions of feet of Republic ELECTRUNITE® Hydraulic Fluid Line Tubing. As a result of their own tests, many equipment and machinery builders and their maintenance departments switched to this quality-proved hydraulic tubing prior to its being included in the JIC Standard.

Like them, you'll get *more tube per dollar* when you specify Republic ELECTRUNITE Hydraulic Fluid Line Tubing. But initial cost savings are only part of the story. *Savings in downtime* reflect even greater cost reductions!

AVAILABLE IN ALL SIZES SHOWN IN JIC STANDARDS BOOK. AVAILABLE IN A WIDER RANGE OF SIZES PRODUCED TO OUR SPECIFICATION HL-1 (WHICH MEETS ALL TEST REQUIREMENTS OF THE JIC STANDARD).

ELECTRUNITE—produced by the world's largest manufacturer of electrically welded hydraulic tubing—is made from flat-rolled steel. *Prime* steel—checked for defects as only flat-rolled steel can be checked. Then: formed, welded, annealed, cold-worked, and annealed again into a tube of *prime* quality . . . a tube that meets or exceeds the normal life of tubing produced by any other method.

ELECTRUNITE'S uniform walls and concentricity, coupled with uniformly high ductility, assure better bending and flaring characteristics. In the *history* of ELECTRUNITE Hydraulic Fluid Line Tubing, no failure resulting from longitudinal or transverse cracks has been reported.

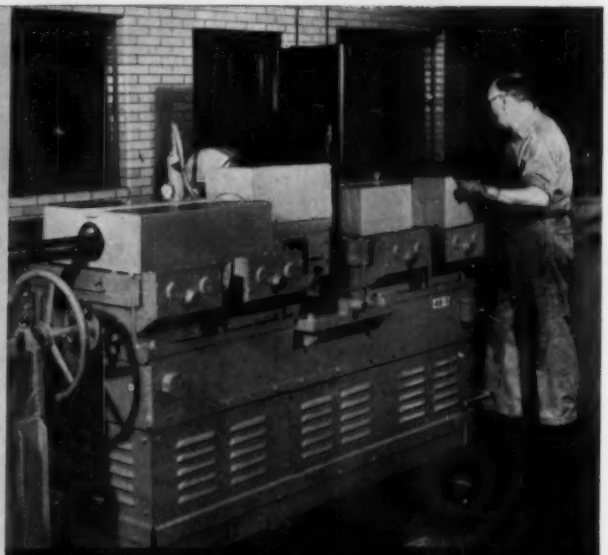
You'll find that ELECTRUNITE Fluid Line Tubing is available in all the sizes shown in the *JIC Standards Book*. Also available in an even wider range of sizes produced to our specification HL-1 (which meets all test requirements of the JIC Standard).

Investigate ELECTRUNITE'S many cost-reducing features. Contact your ELECTRUNITE sales representative or mail the coupon for complete information, including a copy of specifications.

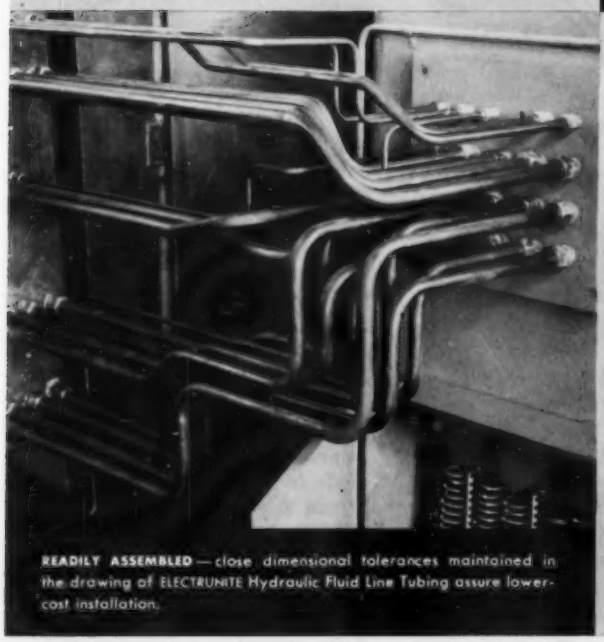
REPUBLIC

World's Widest Range of Standard Steels and Steel Products

HIGH DUCTILITY assures easy bending in any plane. ELECTRUNITE's uniformly high ductility is the result of double-annealing.



QUALITY YOU CAN MEASURE! Specify FARROWTEST® non-destructive electronic testing to MIL-T-17188 or ASTM-A-178 for extremely critical applications. Offered as an alternate to hydrostatic testing at fibre stress of 20,000 psi or an actual pressure of 5,000 psi.



READILY ASSEMBLED—close dimensional tolerances maintained in the drawing of ELECTRUNITE Hydraulic Fluid Line Tubing assure lower-cost installation.

ELECTRUNITE IS EASILY FLARED AND BENT BACK upon itself to accommodate standard or flare-type fittings.

STEEL

STEEL AND TUBES DIVISION

REPUBLIC STEEL CORPORATION
STEEL AND TUBES DIVISION
DEPT. C-8124
211 EAST 131st STREET • CLEVELAND 8, OHIO

Please send complete Republic ELECTRUNITE Hydraulic Fluid Line Tubing information, including a copy of specifications.

Name_____ Title_____

Firm_____

Address_____

City_____ Zone____ State_____

Young Heat Exchangers

Help Reduce Oil Drilling Costs

"...no difficulty with the Young Heat Exchanger being able to maintain proper oil temperature."

IT has been found that the Young Heat Exchanger used to cool the hydraulic pump oil of the Baroid "Mud Centrifuge" does so at great efficiency... using very little water to cool a large volume of oil. Young Heat Exchanger maintains proper oil temperature with trouble free operations. None have been replaced since original installation. The cooling water is not recirculated, but is instead used later in the centrifuging process. The "Mud Centrifuge" is designed to reduce drilling costs by reclaiming (over 95%) weighting materials for re-use. Young heat exchangers are constructed for rugged, dependable service. Young engineers have found that their standard design heat exchangers will serve ideally for many special applications. Remember, too, Young engineers have a vast store of experience working with many types of Heat Transfer problems. Let them apply their knowledge and technical skill to your present or future needs. Call or write your nearest Young representative. No obligation of course.

Write Dept. 449-G for Catalog 1258

Young RADIATOR COMPANY

RACINE, WISCONSIN

Creative HEAT TRANSFER ENGINEERS

Executive Office: Racine, Wisconsin, Plants at Racine, Wisconsin, Matteson, Illinois

Circle **150** on Time-Saver Card

LETTERS

Likes air valve issue

TO THE EDITOR:

Just a note to compliment your organization on the excellent compilation in the April issue of APPLIED HYDRAULICS & PNEUMATICS giving the complete story on available types of air control valves.

It is easy to criticize when things are not 100% to one's liking. This is a good job, more space could have been devoted and perhaps will be in forthcoming issues, once the article is read and demand for such a composite resume is made available.

Thanks for the reprint.

R. W. PETERMAN
Sales Manager
Nopak Division
Galland-Henning Mfg. Co.
Milwaukee, Wis.

Searching for hydraulic impact hammer

TO THE EDITOR:

I am in need of a hydraulic impact hammer which can be handled by one hand. It would be similar to a pneumatic riveter or rivet buster. It seems to me I have heard of such a product being manufactured in Europe. Can you forward to me some information?

M. E. KERNS
New York Central System
Jackson, Mich.

There is no hydraulic impact hammer that we know of being made in the U. S. We've sent an article from our April issue to tell you about a design being made in Australia. You can get more information by writing the author.

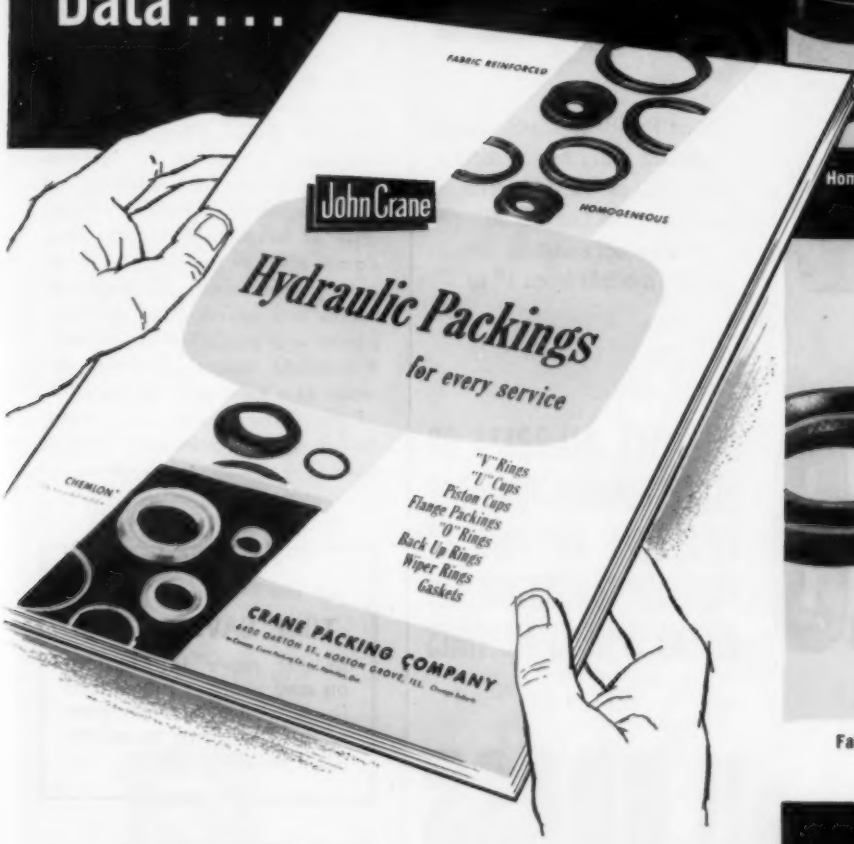
Asks about fire resistant fluids

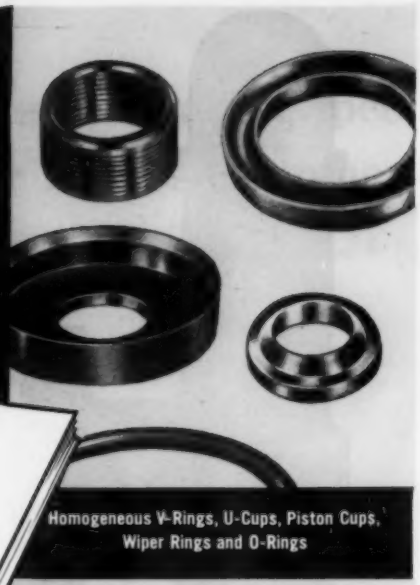
TO THE EDITOR:

We have made axial piston pumps for several years with infinitely variable output. We are selling them as high pressure pumps with variable output or as hydrostatic transmissions for applications needing an infinitely variable number of revolutions. We normally use any pure, acid-free mineral oil for the transmission gears and high pressure

Continued on page 20

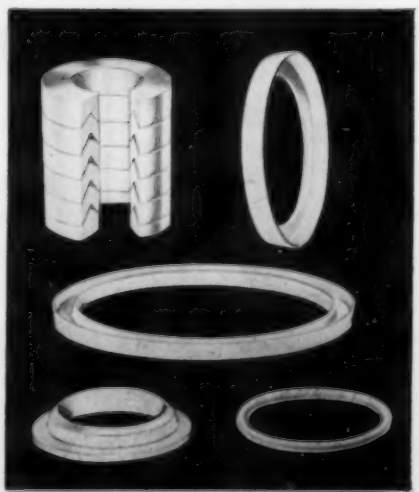
New Hydraulic Packing Designs..... Specification & Application Data....





Homogeneous V-Rings, U-Cups, Piston Cups, Wiper Rings and O-Rings

Fabric Reinforced V-Rings, U-Cups and Piston Cups



Chemlon (Best in DuPont Teflon) V-Rings, Piston Cups, U-Cups, Flange Packings, O-Rings and Back-Up Rings

Here is complete information on the finest available line of hydraulic packings . . . an extremely wide variety of types and constructions, each correctly compounded to particular service requirements and laboratory controlled to insure uniform quality. Available now from "John Crane", this complete line is the answer to practically every hydraulic packing requirement.

Request Catalog 90. You can't afford to be without this detailed engineering guide.

Crane Packing Company, 6405 Oakton St., Morton Grove, Ill. *(Chicago Suburb). In Canada: Crane Packing Company, Ltd., Hamilton, Ont.*

CRANE PACKING COMPANY

all STEEL

New Fulflo all-steel, piston type, oil relief hydraulic by-pass valves combine proven features with the advantages of all-steel construction in flange models from 1" to 2".

FULFLO

ALL-STEEL, ALL-BRASS OR OTHER COMBINATIONS FOR POSITIVE AUTOMATIC PRESSURE CONTROL YOU CAN DEPEND UPON AT ALL TIMES

all BRASS

Fulflo Valves feature shear-closing action for quiet, non-chattering operation. They offer greatest safety, matched to job conditions. Priced right for O.E.M. use . . . built right for superior replacement service.

- Standard and flanged models
- Just 6 springs for pressures to 500#
- Steel, cast iron or brass bodies
- Brass, steel or stainless pistons
- Pipe sizes to 3"
- Specials to your requirements

FREE, completely NEW CATALOG . . . just off the press!

THE FULFLO SPECIALTIES CO., INC.
415 Fancy Ave.—Blanchester, Ohio

Circle **49** on Time-Saver Card

LETTERS

pumps. This oil does not foam and has good lubricating properties. We have recently heard about oils which do not burn, and would like some information about these oils which could be applied for our use.

LOUIS DE ROLL IRON WORKS LTD.
Eisenwoerk Klus
Klus, Switzerland

There are a number of companies presently supplying fire-resistant fluids. They are quite expensive compared to mineral oils—anywhere from four to ten times as much. In their present state of development, they often do not give the same life performance as mineral oils. We have sent names and addresses of the companies now producing these fluids. We would suggest that you arrange to obtain sufficient amounts of the fluids to test your pump. Selection will primarily depend upon the efficient operation of your pump.

use the
TIME SAVER CARD
to get more information on any product mentioned in our product reviews, useful literature or advertised in this issue.

Needs information on valves, pumps

TO THE EDITOR:

I am having difficulty in locating a manufacturer of air-operated hydraulic pumps for pressures to 10,000 psi. I also have been searching for someone who makes stainless steel valves suitable for low pressure pneumatics. Would you be able to assist me in this matter?

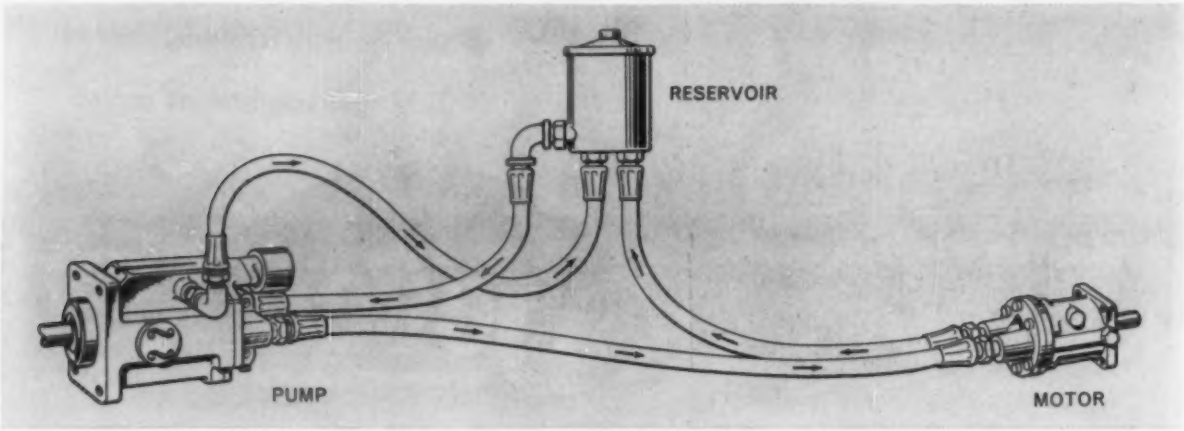
A. PALMGREN
A. Palmgren Automotive & Industrial Equipment
Stockholm, Sweden

We've sent a list of manufacturers in this country for the items you request. Since your letter specifies stainless steel valves, your final problem will be one of cost.

Creative hydraulics by Sundstrand

Variable input—constant output speed transmissions designed for mobile equipment

Compact, lightweight, highly efficient hydrostatic transmissions develop up to 9 hp



32 PV Variable Displacement Pump

Reservoir 1½-Quart Capacity

7MC Fixed Displacement Motor

Here's a new idea in boosting efficiency of constant output speed auxiliary operations on mobile equipment. Compact, high-efficiency hydrostatic transmissions designed to use low-cost piston-type pumps and motors are being introduced in six standard sizes by Sundstrand—a company with more than 10 years' experience in constant speed drives.

Principal components of the Sundstrand hydrostatic transmission as shown at the left are: (1) Variable displacement axial piston pump, (2) a fixed displacement axial piston motor, and (3) a small (1½-quart) reservoir. Output horsepower depends on input speed range (see table at right).

Motor speed remains constant within ±5% despite variations in pump input speed because of the unique control. The pump continually measures its own output and makes adjustments automatically in order to deliver a constant flow of oil.

By adding a small independent manual control to the circuit, pump delivery may be regulated to vary output speed of the motor from zero to maximum RPM. Constant motor output speed is maintained at any particular valve setting.

System is unusually compact and light in weight. There's no spilling of oil over a relief valve or bypassing of oil under pressure as pump delivers only the amount of oil needed. High efficiency is obtained —therefore there is no problem of heat dissipation.

Typical Hydrostatic Transmissions

OUTPUT H.P.	PUMP INPUT SPEED RANGE—RPM	MOTOR CONSTANT OUTPUT SPEED RPM ± 5%*
2 hp	300 to 3000	1200
3 hp	450 to 3000	1800
4 hp	600 to 2500	2400
6 hp	800 to 2400	3000
8 hp	850 to 2300	3300
9 hp	950 to 2200	3600

*Under normal rated load conditions, motor output speed can be held constant within ±5%.

Typical applications for Sundstrand hydrostatic transmissions include: Alternator drives on construction and fire-fighting equipment, refrigeration compressor drives, fan drives in air conditioned buses, and conveyor drives on agricultural, construction and mining equipment.

Sundstrand hydrostatic transmissions can be the answer to your power requirements. Get more facts by sending a brief outline of your needs to address below.

SUNDSTRAND

SUNDSTRAND HYDRAULICS

DIVISION OF SUNDSTRAND CORPORATION

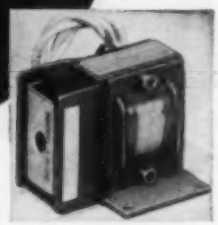
2210 Harrison Ave., Rockford, Ill.—Eastern Sales Office: 89 Summit Ave., Summit, N. J.

AIRCRAFT AND INDUSTRIAL HYDRAULIC TRANSMISSIONS, PUMPS, MOTORS AND VALVES • OIL BURNER PUMPS • AIR SANDERS • LATHES, MILLING, BROACHING AND SPECIAL MACHINES • BROACHING TOOLS • MAGNETIC CHUCKS • PACKAGING MACHINERY

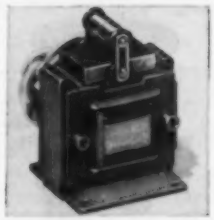
- Up to 30 pounds force. Push or pull.
- Full one inch stroke available.
- Decco shock-mounted for long life.
- High efficiency—silicon steel laminations.
- High moisture resistance.
- Shock absorbing bumpers cushion stroke.

Decco
SERIES
50

INDUSTRIAL SOLENOIDS



Your choice of mounts



Push or pull types

Direct current solenoids

Decco's Series 50 offers more power—longer stroke with the same dependable quality and performance that has made Decco the top name in industrial solenoids.

There is a Decco solenoid for every requirement. Built to give better service for a longer time. Solenoids engineered and modified to your requirements. Let us discuss your problems.

For complete information write—

Decco SOLENOIDS
THE HEART OF DEPENDABLE AUTOMATION EQUIPMENT

DETROIT COIL COMPANY

2435 HILTON ROAD, FERNDALE 20, MICHIGAN

RIVETT SQUAREMASTER "100" CYLINDERS

Unfailing POWER for MILLIONS of cycles!

Here's sure power for unfailing cylinder operation. SQUAREMASTER 100's are the world's finest constructed cylinders—perform with 100% efficiency! 200 P.S.I. air to 500 P.S.I. oil. Available in 7 mountings with standard dimensions, in 10 bore diameters, internal and external threading. Special models and cover combinations. Priced competitively; prompt delivery; meet all J.I.C. requirements.

RIVETT, INCORPORATED
Dept. AH-7, Brighton 35, Boston, Mass.

*Initial High Coefficient of Static Friction

POWER-PACKED FEATURES PROTECTED BY POWER-GUARD CONSTRUCTION

1. Piston rod. Ground and polished alloy steel. Hard chrome-plated. **2.** Piston rod bearing. Replaceable cartridge-type. **3.** Piston packing adjusts automatically. V-block packing minimizes friction. **4.** Correctly stressed tie rods. **5.** Cushion bushings. Bronze, floating type. **6.** Ports rotated to any 90° position. **7.** Steel covers. Take minimum mounting space.

Send for catalog. Proof of SQUAREMASTER efficiency stated in these 20 pages. Write today.

RIVETT furnishes a complete power package

AIR AND HYDRAULIC—VALVES, CYLINDERS, POWER UNITS

Member — National Fluid Power Association

ANOTHER OF THE GARLOCK **2,000**

Metal plates, spot-welded together, provide cup with backing entirely of metal ("A"), are stepped to give metal to metal contact ("B").

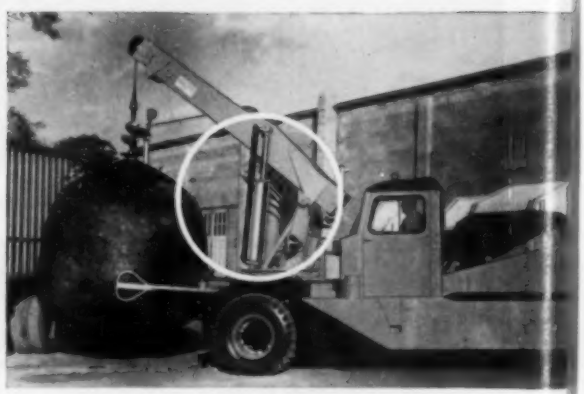
Where SERVICE is TOO ROUGH for ORDINARY CUPS...

Garlock Metal-Backed Cups offer positive sealing

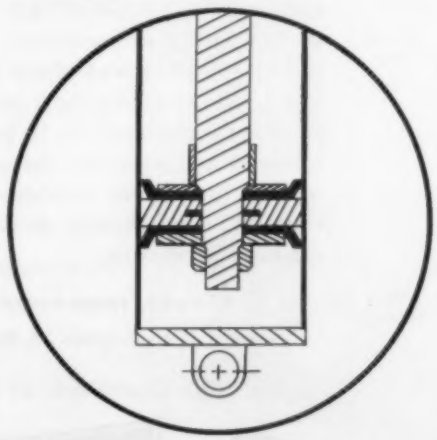
A new, patented Garlock Cup construction provides metal reinforcement across the back and through the center of the cup. Under pressure, they actually support themselves without extruding at the heel. And, by bolting the cups to the back-up support of the piston assembly, a metal-to-metal contact is established—once tightened, it never loosens . . . eliminates compression loss.

Garlock Metal-Backed Cups help assure safe, smooth hydraulic operation of cylinders on heavy duty equipment such as the hydraulic crane illustrated at right.

Available in widely-used fabric, or in synthetic rubber. Garlock Metal-Backed Cups come in standard sizes ranging from 1½" to 14½". They are another important part of the Garlock 2,000 . . . two thousand different styles of packings, gaskets, and seals for all your needs. Let your Garlock representative recommend the best style for your application. Call him, or write for bulletin AD-145.



Garlock Metal-Backed Cups are used for dependable operation of hydraulic cranes manufactured by Grove Manufacturing Company, Shady Grove, Pa. Circle indicates hydraulic cylinder on which cups are used.



THE GARLOCK PACKING COMPANY, Palmyra, N. Y.

For Prompt Service, contact one of our 26 sales offices and warehouses throughout the U. S. and Canada.

GARLOCK

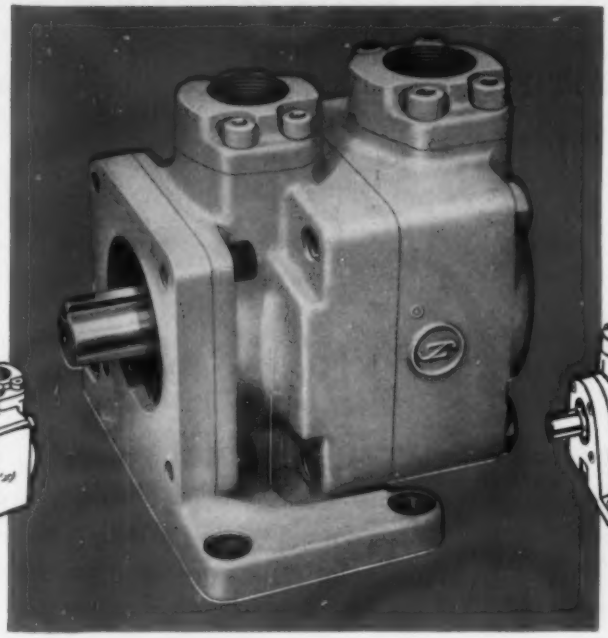
Packings, Gaskets, Oil Seals, Mechanical Seals, Molded and Extruded Rubber, Plastic Products

Canadian Div.: The Garlock Packing Co. of Canada Ltd.—Plastics Div.: United States Gasket Co.

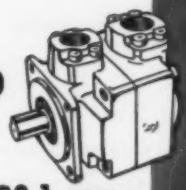
Circle **51** on Time-Saver Card

HYDRECO® Announces—

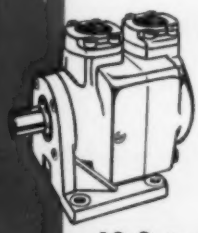
TWO NEW SERIES OF DUAL-VANE PUMPS FOR 2000 PSI CONTINUOUS OR INTERMITTENT OPERATION



PF-200



14.5 to 38.1 gpm at 1200 rpm-0 psi



PF-300

43.0 to 72.5 gpm at 1200 rpm-0 psi

CHECK THESE FEATURES

The greater efficiency and economy of 2000 psi *single stage* operation.

●

Dual-Vane construction—the proven principle of hydraulic balance—higher mechanical and volumetric efficiency.

●

Improved design of cam ring provides greatly increased cam life.

●

Two sizes give complete range of capacities from 14.5 to 72.5 gpm . . . PF-300—300 Double Pumps give capacities to 144 gpm.

●

Cartridge construction . . . Pump rotation can be changed by merely reversing cartridge.

●

Housing ports can be rotated to any position 90° to each other.

Member NFPA

NFPA NATIONAL FLUID POWER ASSOCIATION

Design engineers, seeking Vane Pumps that deliver substantial improvement in performance, longer service life and higher over-all efficiency will find much of interest in these HYDRECO Dual-Vane Pumps. Whether the application imposes the exacting performance of automated production machinery or hydraulic presses, these HYDRECO Dual-Vane Pumps possess the long-sought extras.

For continuous or intermittent 2000 psi operation, these Pumps are outstanding. Within the capacity range of 14.5 to 144 gpm obvious applications include: Injection Molding, Die Casting, Hydraulic Presses, Scrap Balers and Metal Working Machinery. There are many other areas wherein the advanced design and high performance features of HYDRECO Dual-Vane Type Pumps will excite special interest. Write for full information today.

Write **for Bulletin 10420.1 and performance data**

HYDRECO DIVISION
THE NEW YORK AIR BRAKE COMPANY
9004-7 EAST MICHIGAN • KALAMAZOO • MICH.

Please send me Bulletin 10420.1 and performance curves on Series PF-200 and PF-300 HYDRECO Dual Vane Hydraulic Pumps.

Name_____

Company_____

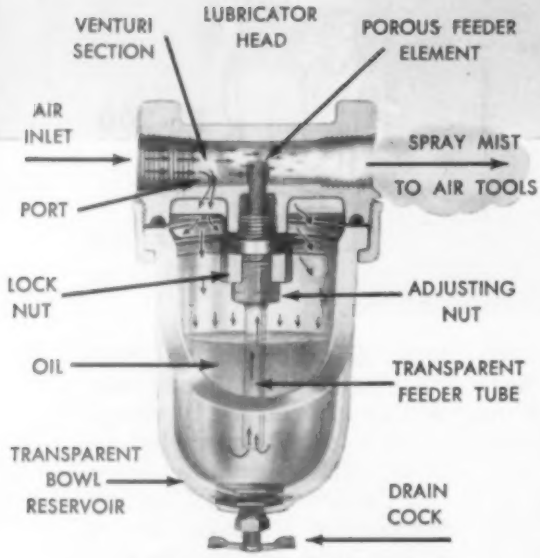
Address_____

City_____ Zone_____ State_____

Arrow AIRLINE SPRAY MIST LUBRICATORS

Supply a fine Spray Mist Lubricant by the most efficient and effective two-stage method!

By PRE-DIVIDING or breaking up the oil in the first stage before completely atomizing the Lubricant in the second stage. The Spray Mist is then carried along throughout the entire pattern of the air stream to lubricate the working parts of air-powered tools, cylinders, valves and other pneumatic devices.



Illustrates the operation of the ARROW "patented" two-stage, tamper- proof Lubricator.

Compressed air from the drop line enters the Lubricator to Venturi section of the Lubricator Head where the porous feeder element protrudes into the Air Stream.

Small ports in front of the porous feeder permits air pressure transfer on the oil surface in the bowl reservoir. The pressure differential created by the Venturi forces the oil to rise in the transparent feeder tube, into and through the porous feeder element which PRE-DIVIDES the Lubricant in this first stage, into minute particles of oil.

The Lubricant now finely divided and saturating the porous feeder element, is now easily and most efficiently atomized from the feeder element, at this second stage, by the action of the Venturi on the compressed air passing through the Lubricator Head.

The two-stage method incorporated in the ARROW LUBRICATOR insures a fine spray mist for wider ranges of AIR FLOWS at lower pressure drops.

Simplicity of design with only one tamper-proof adjustment provides for most efficient, low-cost operation.

PROTECT YOUR PNEUMATIC EQUIPMENT

Complete Conditioning and Control of Compressed Air Prolongs Service Life, Reduces Maintenance and Repair of Air-Powered Tools, Cylinders, Valves and Other Pneumatic Equipment.

the most Efficient and Complete AUTOPNEUMATIC CONTROL By Arrow

A choice of fine or coarse grade porous Bronze Feeder Wick as required for lubricant or application. A choice of Hand Filling Type Lubricator or a Pressure Filling Type with Button Head Fitting or the ARROW . . . New Fully Automatic Filling Type which with the Automatic Drain Trap makes Autopneumatic Control completely automatic, eliminating all hand or manual servicing.

Many Types and Models of Single Units and Units in Combination Assemblies to Meet Specific Requirements.

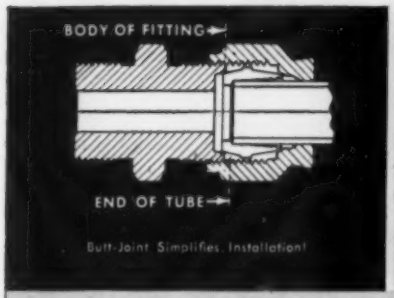
PIPE LINE SIZES—
¼"—⅜"—½"—¾" and 1" N.P.T.

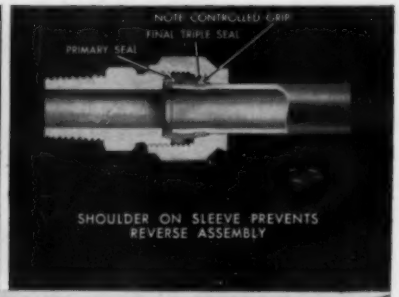
Catalog and Engineering Data Sent on Request.

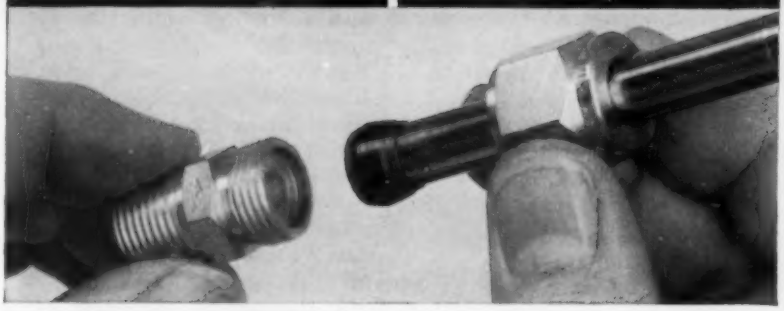
ARROW TOOLS, INC. 1934 S. KOSTNER AVE. CHICAGO 23, ILL.

IMPERIAL *Engineering and Data File*

ENGINEERED TUBE FITTINGS — VALVES — TUBING TOOLS



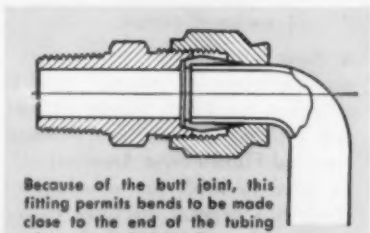




How Hi-Seal tube fitting design simplifies instrumentation piping layouts

The butt-joint feature of Hi-Seal fittings is a design consideration acclaimed by fitting users throughout industry. The tube *does not* enter body of fitting! It bottoms on the shoulder of the sleeve. This butt joint feature makes possible far more compact piping layouts than other fittings.

Users have obtained these benefits: (1) cuts space requirements up to 50%; (2) reduces number of bends required; (3) cuts man hours and installation time; (4) substantially reduces the amount of tubing needed; (5) permits the use of straight lengths of .028″ copper tubing in bending temper instead of .032″ soft tubing in coils; (6) ends need for straightening.



Because of the butt joint, this fitting permits bends to be made close to the end of the tubing where space is limited.

FOOLPROOF ASSEMBLY — Anyone can make leakproof connections with Hi-Seal fittings. There is only one way to assemble the Hi-Seal fitting . . . only one way tubing can go into sleeve . . . only one way sleeve can go into fitting.

Hi-Seal design also makes maintenance of equipment easier through quicker disassembly and assembly of joints — may be disconnected and reconnected as often as desired.

COMPLETE LINE — Hi-Seal fittings are available in brass, steel, stainless steel. Also can be furnished in Titanium, Tantalum and other metals. Steel fittings supplied with cadmium plate or black phosphate finish. Conform to J.I.C., A.S.M.E. and A.S.A. standards. In sizes for ⅛″ to 1½″ O.D. tubing. Furnished with Long Dryseal pipe threads or straight thread port seal.

Write for Bulletin No. 3061

New high-pressure valves assemble directly to tubing, eliminate additional fittings

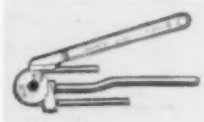
A revolutionary new line of Imperial needle valves designed for working pressures up to 5,000 psi., and temperatures to 450° F., employs Hi-Seal tubing connections.

These valves attach directly to tubing and eliminate additional fittings. This not only reduces cost but cuts installation time and eliminates principal source of leakage.

For low pressure instrumentation service, Imperial also supplies a complete line of fluid control valves in diaphragm, plug, (2, 3, and 4-way styles) — needle and toggle types.

Write for Bulletin 3096, or Catalog No. 200

Dimensional Bends easily made with Imperial Blue Dot Benders



It's no trick to make bends at any desired point — that conform to dimensional requirements as to developed tube length and location — when you use Imperial Blue Dot Benders. Full instructions with each bender.

Imperial Benders are of the open side type. They slip over the tubing where the bend is desired — handy in hard-to-get-at places or when tubing has one end connected.

They form neat, accurate bends on hard or soft tubing without annealing. Calibrated for bending any angle up to 180°.

Wide range of individual and combination benders for 2 to 7 sizes — from ⅛″ to ⅞″ O.D. (⅛″ to ¾″ nom.).

Write for Bulletin No. 3088

CONTACT YOUR INDUSTRIAL DISTRIBUTOR OR WRITE TO:

THE IMPERIAL BRASS MFG. CO.
Dept. AH-79, 6300 W. Howard St., Chicago 48, Ill.

Please rush me: Bulletins ☐ No. 3061 ☐ No. 3096 ☐ No. 3088 ☐ Cat. No. 200

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IMPERIAL

THE IMPERIAL BRASS MFG. CO.
6300 W. Howard St., Chicago 48, Illinois
In Canada: 18 Hook Ave., Toronto, Ontario

BRIEFS

about fluid power

NFPA ADOPTS LIST OF CYLINDER BORE AND ROD SIZES

ASHEVILLE, N. C.—Specifications and procurement of hydraulic and pneumatic cylinders will be simplified as a result of the action taken by the National Fluid Power Association. At its annual meeting on May 18, the association adopted suggested sizes of bore diameters and piston-rod diameters.

The series are based on a survey of more than 300 manufacturers of cylinders. Over 100 companies contributed data indicating preferences of diameters for future designs. The suggested series have been refined from these data. The new series contain only about 25 percent of sizes now in common use.

SUGGESTED CYLINDER SIZES

Bores (in.)	1, 1⅛, 1¼, 1½, 2, 2½, 3, 3¼, 3½, 4, 4½, 5, 6, 7, 8, 10, 12, 14, 16, 20
Piston Rod Dia. (in.)	5/16, ⅜, ½, ⅝, 11/16, ¾, ⅞, 1, 1⅛, 1¼, 1⅜, 1½, 1¾, 2, 2¼, 2½, 2¾, 3, 3½, 4, 4½, 5, 5½, 6, 7, 8, 9, 10

Another step forward made at this NFPA meeting was the acceptance of parts of the "Dimension Identification Code for Fluid Power Cylinders." The code establishes a system for dimensioning which includes:

1. A fixed reference point for all cylinder and mounting dimensions.
2. Envelop dimensions.
3. Port sizes and locations.
4. Mounting dimensions.
5. Piston rod connection dimensions.

The object of this code is to have uniform methods of dimensioning in literature from all manufacturers of air and oil cylinders.

• **Terminology**—NFPA's technical board has a committee attacking the problem of a common language for fluid power. The goal is to list and define terms used in the fluid power industry. Over 1300 definitions are in process. Topping this impressive list are:

FLUID POWER—

Power transmitted and controlled through use of a pressurized fluid.

FLUID POWER SYSTEM—

A system that transmits and controls power through use of a pressurized fluid within an enclosed circuit.

• **New officers** — Sixty-seven manufacturers of pumps, valves, cylinders, packings, fluids, filters and fittings are members of the National Fluid Power Association. Founded in 1953, the association holds two general meetings each year. It has active technical, management services, and marketing boards. Officers elected at the spring meeting are: president, Lynn L. Charlson, Char-Lynn Company; 1st vice-president, Frank Flick, Flick-Reedy Corp.; 2nd vice-president, W. C. Richards, Jr., The Bellows Company; treasurer, W. B. Kuhnke, Hanna Engineering Works. New directors elected to the board are: R. W. Peterman, Galland-Henning Mfg. Co., R. R. Stevens, Westinghouse Air Brake Co.; G. T. Lyon, L&L Mfg. Co.; B. P. Pierce, Berry-Hydraulics; and Otto Maha, Parker-Hannifin Corp.

• **Market information** — One of NFPA's objectives is to maintain statistics on dollar volume of fluid power components. A program to gather and maintain this information was outlined by H. A. Schultz, v-p of sales, Racine Hydraulics. Based on a report from BDSA, (Department of Commerce Bureau gathering industry statistics) Schultz estimates that combined sales of NFPA members is about $200,000,000 a year. The proposed plan to provide market data requests each NFPA member to:

1. Estimate by percentage of total sales the volume of each product group in their line. This would provide a formula for breaking down total dollar figures into product groups.
2. Submit monthly dollar sales figure.

These figures will permit preparation of sales charts showing trends. This is similar to information presently released by many trade organizations. □□□

"Hula Head" Is A Cutting Sensation

Tracer controls, consisting of pneumatic and hydraulic components, are an integral part of the "Hula Head"; a revolutionary machine capable of cutting compound contour structural shapes from honeycomb core material.

Unlike other operations, you get required tolerances and finishes without using filler substance to rigidize the sandwich-like core during machining.

The "Hula Head" is a standard, three-axis controlled cutting ma-

Continued on page 30

Push Operated, Detented or Spring Return.
Lever Operated, Detented or Spring Return.
Pilot Operated Spring Return.
Double Pilot Operated.
Pilot Operated Bucking Cylinder Return.
Single Solenoid Spring Return.
Double Solenoid Momentary Contact.

HUNT

new unique Slim Line

CONTROL VALVES

Now available with 8 types of operators. 3-way and 4-way actions. Easily manifolded into compact control centers.

● You'll like these new valves. Only 1" thick by 3" wide, they are exceedingly compact and light in weight; can be mounted easily on machines even when space is extremely limited.

Ideally suited for controlling small cylinders, to operate pilots and similar services. ⅛" or ¼" pipe tapped. Pressures to 125 p.s.i. Air, water, oil or vacuum service. Stock delivery.

Solenoid valves have the following features as standard; manual over-ride; ½" NPT conduit connections; valve inoperative with solenoid cover removed.

The side of each valve is counter-bored, trepanned for an "O" ring, and provided with four through holes permitting up to eight valves to be manifolded together and operated from a single supply. Better get full details — now!

Six Single Solenoid Valves Manifolded into a Compact Unit Using Standard Brackets and Tie Rods.

More startling HUNT designs to come!

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Manufactured by HUNT VALVE COMPANY, 1991 East Pershing St., Salem Ohio

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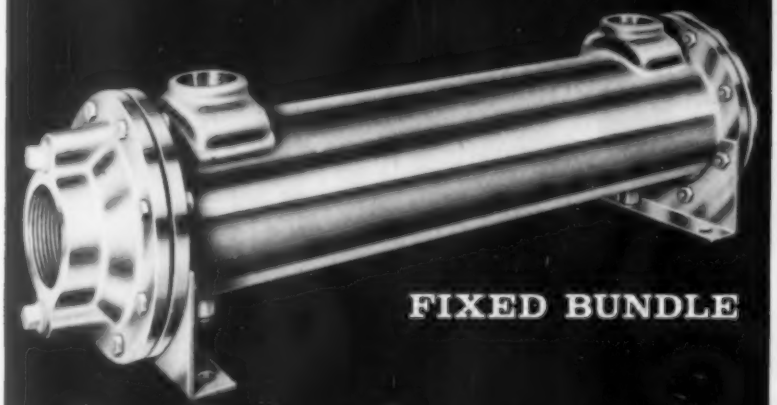
FOR CORROSIVE TYPES OF HYDRAULIC OILS...



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WRITE FOR BULLETIN HT-21

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HEAT EXCHANGERS / RADIATORS / AFTERCOOLERS

Circle **149** on Time-Saver Card

BRIEFS

chine equipped with a newly-designed portable head and a modified stylus which can convert cutting to a five-axis operation.

With five pick-up points, the stylus rides the surface of a model and transmits rise, fall, and tilt motions to the cutter head. The

knife edge, on the cutter head, performs duplicate motions in cutting the honeycomb core.

The cutter head can tilt ±10° in two directions, perpendicular to each other, and there is a common focal point on the centerline and cutter end. Power is supplied by an air motor developing 12,000 rpm.

Made by The Martin Co., Baltimore Division, "Hula Head" gets its name from the versatility of motion in cutting. □□□

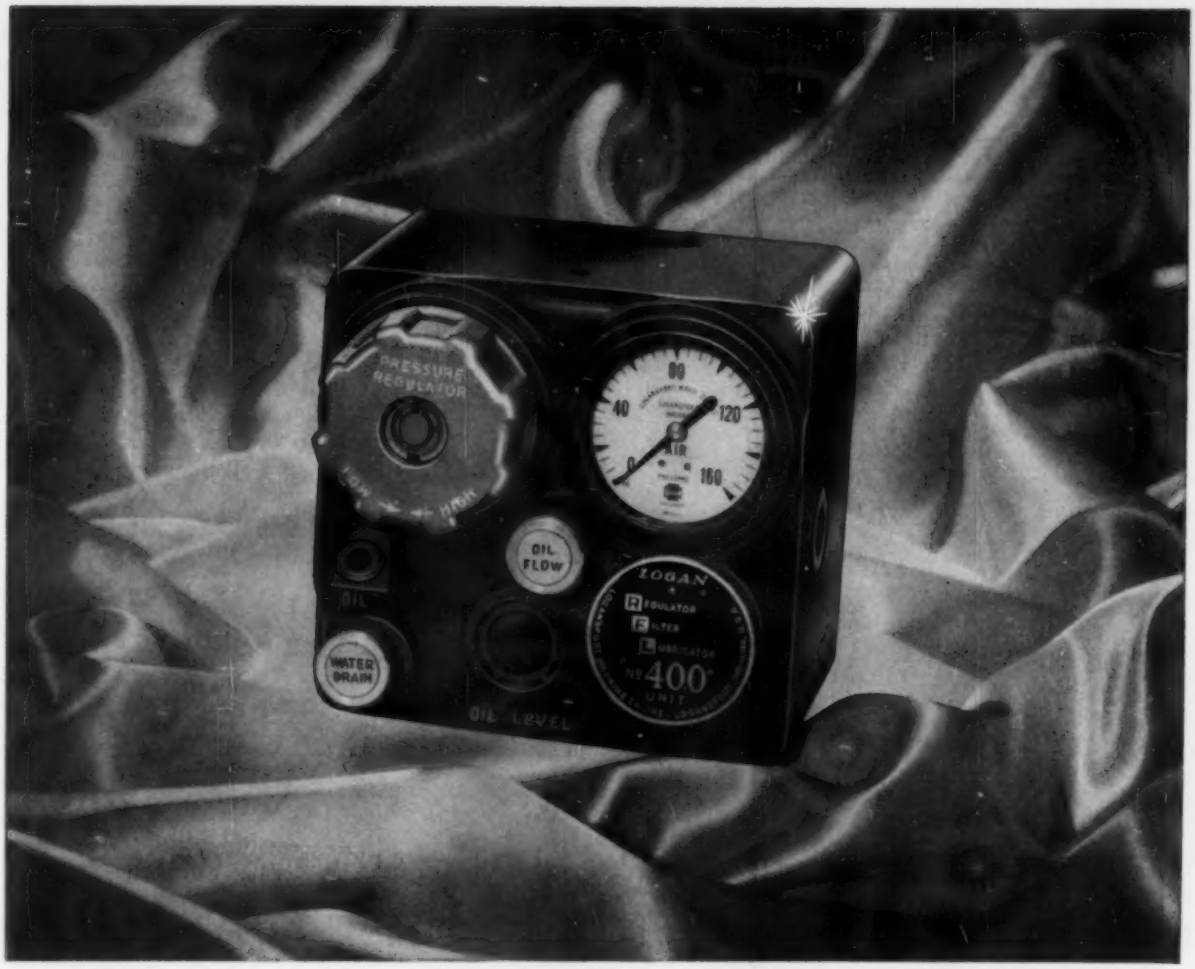
Feed Mechanism for Accuracy, High Production

A new feed mechanism that has the best features of mechanical and hydraulic drives is a major factor in meeting requirements for extreme accuracy and high production in the Model MTA-7 slicing machine.

Manufactured by The DoAll Co., Des Plaines, Ill., the machine may be used wherever hard or brittle material must be sliced quickly and accurately. Thickness of the slices is limited only by the cutter width and material characteristics.

The cross feed mechanism is set with a handwheel graduated in "tenths" for any automatic index

Continued on page 32



Illustrated—Logan Model 400 RFL Unit

Look to Logan

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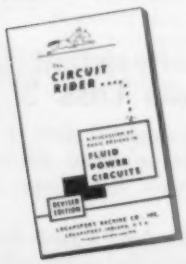
Logan RFL Unit, the designers choice for over a decade! Protects your air-powered equipment . . . regulates pressure . . . filters air . . . lubricates air. Adds years of dependable performance.

New Model 400, illustrated above, is a companion model to the well-known Model 600.



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For Hydraulic, Pressure Feed, Transfer Work

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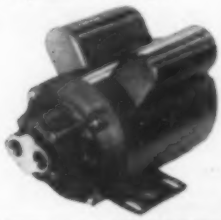
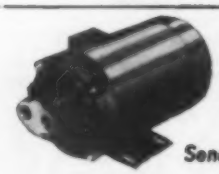
Pressures to 400 PSI

NOW... A CHOICE OF 192 MODELS

Roper has expanded its line of Series T rotary pump units to take care of a wider range of uses pumping clean liquids. These "all-in-one" units, with pump serving as the end bell of the motor, are easily installed and have minimum space requirements . . . no coupling is required . . . each unit is approximately same size as standard NEMA motor of HP required for driving. For your specific application consult the Roper representative in your vicinity.





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- **LIGHT WEIGHT**

Roper Series T units are available in short, low and larger units with open drip proof or totally enclosed motors, single or three phase as required. Typical applications include: hydraulic door openers, work table movement, hospital beds, dental chairs, general transfer, as well as metering jobs on a wide variety of applications.

Send for Bulletin 31

ROPER HYDRAULICS, INC.
707 Blackhawk Park Avenue
Rockford, Illinois

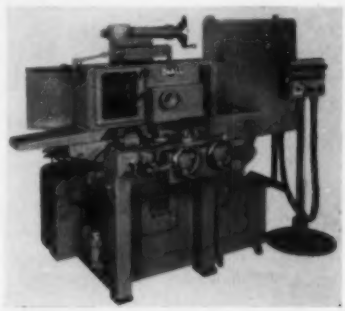
ROPER
ROTARY PUMPS

Circle **118** *on Time-Saver Card*

BRIEFS

from 0 to .100". An alloy steel 1¼" diameter cross feed screw serves as the saddle index. An overriding clutch connects this screw to a pinion gear, which engages a rack moved by a double-acting hydraulic cylinder. The clutch allows the screw to be turned only when the cylinder is moving the rack in one direction. It can not be turned during the cylinder's return stroke.

Because of the load sensitive feed control, the MTA-7 virtually thinks for itself. Thus, cutting



wheel loading can be selected for best accuracy; surface finish and tool life for desired production rate.

The heart of the unit is a sensitive relay-meter that indicates minute changes in the drive motor amperage. Amperage change is proportional to change in cutting wheel loading. The relay-meter is adjustable to complete a circuit at any predetermined loading. This closes a solenoid valve in the hydraulic feed cylinder circuit. All flow to the cylinder must then pass through an adjustable orifice in parallel with the solenoid valve, adjusted for any rate below normal feed. When the load drops to the preset amount, the valve reopens and flow bypasses the adjustable orifice. □□□

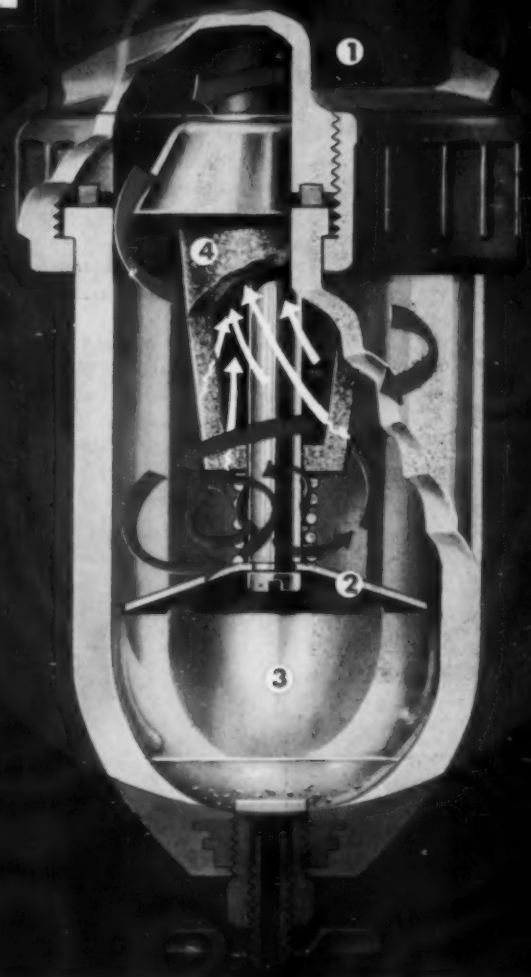
Leak-Resistant Oil Cuts Loss 35%

Recently completed field tests show that leak resistant oils can reduce hydraulic fluid losses by 35%.

This test involved a centralized lubrication and hydraulic system

Continued on page 34

Circle 143➡



Curved inlet **1** directs incoming air in downward helical pattern. Larger impurities and condensate are "thrown out" by centrifugal action, collecting on bowl sides and spiraling downward past baffle **2** into quiet chamber for draining-off. Baffle traps sediment in quiet chamber **3** and allows only dry air centrifugally cleaned of larger impurities to reach filter element **4** where finer particles are filtered out.

New "TORNADO ACTION" of high-efficiency filter really cleans air flowing to pneumatic equipment

You add service life to equipment and reduce maintenance costs to the minimum with Watts High-Efficiency air line filters. The exclusive Tornado Action designed into Watts filters delivers really *clean* dry air.

You can expect *high efficiency* from the advanced-design Watts line of filters, regulators and lubricators. Specialists in protection and control devices since 1875, Watts is creating new *standards* of efficiency in pneumatic operation.

WATTS REGULATORS — sensitive "ASPIRATOR ACTION" maintains more uniform pressure

Aspirator acts directly on diaphragm giving instant compensation for fluctuating loads . . . provides precise control and stabilizes pressures reaching individual pieces of equipment.

WATTS LUBRICATORS — exclusive "BY-PASS PICK-UP" assures efficient lubrication

High velocity venturi section provides efficient atomization at air flow rates as low as 1 CFM. Automatic bypass valve assures complete atomization with negligible pressure drop at high air flow rates. Result: wide range performance *in a single unit.*

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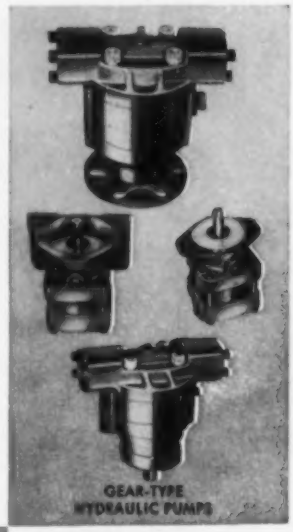
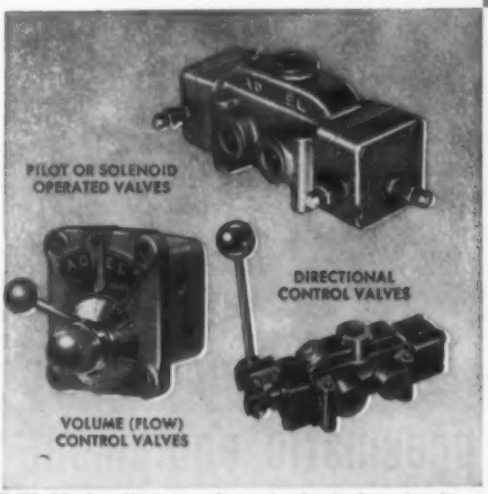
Modernize and automate your existing machines with ADEL Hydraulic Pumps, Motors and Control Valves. Machine builders for the industrial, construction and agricultural fields specify ADEL components as standard equipment.





ADEL Hydraulics' experience in the design, development and precision production of hydraulic equipment has produced components of unusual reliability, efficiency and economy. These proven Pumps, Motors and Control Valves, available in a wide variety of types, sizes and mountings, may mean new economies in your hydraulic system costs.

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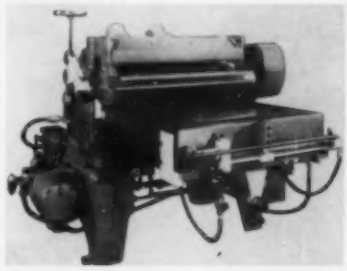
Circle **3** *on Time-Saver Card*

BRIEFS

for compressor and air exhaust equipment servicing various high speed tunnels and test stands. A self-contained circuit within the hydraulic system was isolated. Leakage from individual joints was measured before and after charging the circuit with leak-resistant oil.

Findings showed oil previously leaked about a pint each day, compared to one ounce in 18 days after changeover. On an overall basis, leakage is estimated at about 4000 gals. yearly.

Tests were conducted by the Sun Oil Co., Philadelphia. □□□



OPERATED HYDRAULICALLY, this table travels three ways. Work is held mechanically or by steam. Made by Clair Mfg. Co., Inc., Olean, N. Y., this surface finishing machine has a single-roll design. Adjustments are for in, out, and sideways movement. New design provides sensitive floating action of roll. It's free to follow curvatures at any preset uniform contact pressure. To insure automatic counterbalancing of this action, roll pressure cylinder is actuated by two compressed air circuits, individually complete with accumulators, adjustable automatic pressure regulators, and coordinating controls.

Briefs from Britain

Two British firms have introduced machines for use in bending processes. The first, by Chamberlain Industries, Ltd., London, is used to facilitate making accurate radius bends in hydraulic tubing. It's a chart and angle-of-bend-indicator for use with the company's two-state bending equipment.

The Chamberlain angle-of-bend indicator consists of a hollow chromium-plated rod, graduated

Continued on page 38

For every industrial and automotive application... the complete line of non-skive

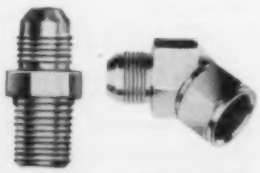
ALEMITE SURGEPRUF®

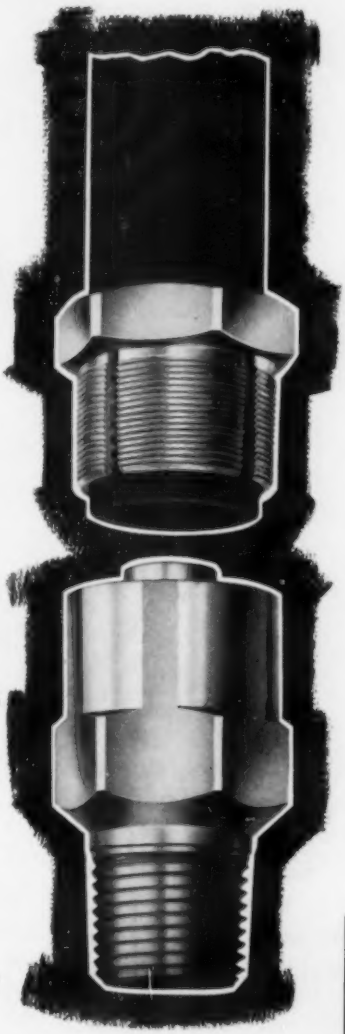
Couplings. Made of high-strength steel, dichromate plated. "Double-wedge grip" forces coupling threads through rubber cover . . . grips either single- or double-wire braid firmly. Saves both time and labor!

Medium-high and high-pressure hose and reusable couplings. Single and double wire braid hose. Non-skive feature assures fast, easy assemblies. Seamless inner tube of Buna-N rubber and Neoprene outer cover. Resists abrasion, weather and oil. No special tools required.

New Low-Pressure "Shur-Lock" Hose. For use on fuel, filter, oil, air and vacuum gauge lines. Rugged, precision-matched couplings. Leak-proof grip.

Adapters and swivel adapters. Full range of sizes in J.I.C. and other threads. One-piece adapters—and swivel union adapters to simplify assembly and avoid twisting strain in cramped quarters.





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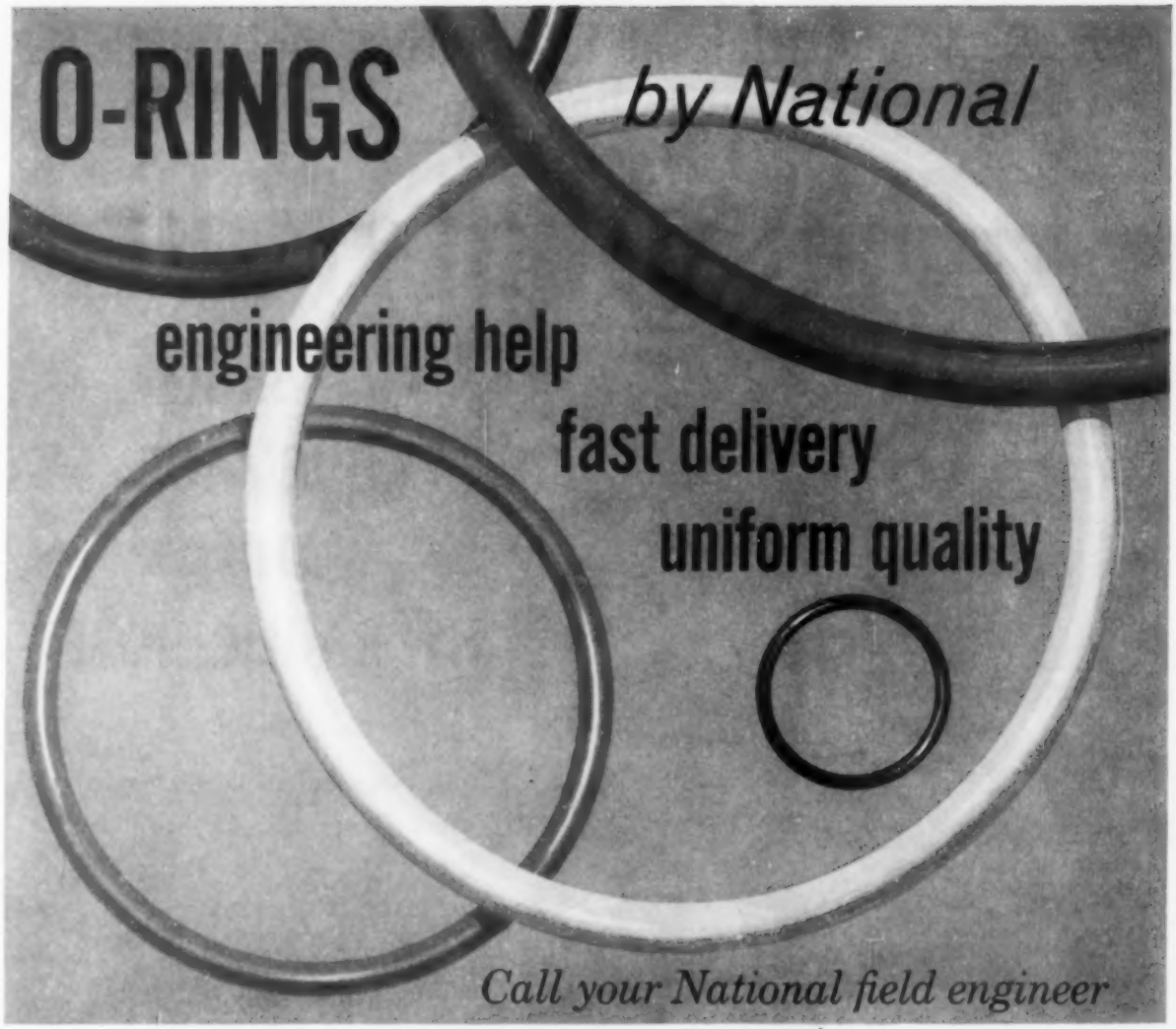

National O-Rings are precision made, uniform commercial rings available throughout the United States—promptly! Quality is superior; all ingredients are inspected before compounding and compounding is strictly controlled for maximum uniformity. Molding is done on modern equipment by veterans of 20 years in O-Ring manufacture. Every precaution is taken to insure that no O-Rings with cuts, scratches or mold defects are shipped.

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He's mopping up the mess for the last time

At a leading aircraft research center, high-frequency vibration caused severe oil leakage from hydraulic lines servicing a huge wind tunnel. Many man-hours each month were wasted cleaning up the basement floor underneath, even though drip pans were used extensively.

Now, after a change to a Suntac oil, the vibration-caused leakage has been reduced to a point where "mop-up" is not needed. Hydraulic-fluid consumption has been cut by 4000 gallons a year. That's economy! That's Sun quality—the best economy of all.

If your plant is troubled with a leaky system, a Suntac antileak hydraulic oil can save you money, too. Ask your Sun representative to show you the Suntac desk-top demonstration, or write direct to SUN OIL COMPANY, *Philadelphia 3, Pa., Dept. AH-7. In Canada: Sun Oil Company Limited, Toronto and Montreal.*

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HILCO OIL RECLAIMER

HILCO Oil Reclaimer purifies vacuum pump oil by continuous recirculation, either on a full-flow or by-pass basis, or intermittently on a batch basis, depending on the requirements and physical layout of your plant.

HILCO OIL RECLAIMER SYSTEMS are the finest available for VACUUM PUMP users . . .

A simple, economical and efficient method of restoring contaminated lubricating and sealing oil to the full value of new oil. A HILCO will produce and maintain oil free of all solids, sludge, acid, moisture, solvents, and dissolved gases and it will restore viscosity, dielectric strength and other specifications to new oil value. HILCO oil reclaimers are in wide use for purification of vacuum pump oil in many manufacturing operations.

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Circle **66** on *Time-Saver Card*

BRIEFS

in inches, which slides in a housing fitting on the forming head. This scale registers the amount of ram extension during bending.

Degree of bend required is found on an engraved chart, once the stroke of the ram is known.

No calculation is required. The length of the arc may also be determined by using the chart so the exact length of tube may be cut.

A new pipe-bending machine was recently designed and manufactured for the Government of Qater on the Persian Gulf by Tubela Engineering Co., Ltd., of Ilford. It's suitable for bending 8 and 10 in. nominal bore pipe, cold and unloaded.

The Tubela machine is powered by a 5 hp diesel engine and is equipped with two 4-inch diameter

rams, having a 12-inch stroke. Rams impose a load of 11½ tons on the low-pressure cycle, up to 52 tons in high-pressure operation.

Engine and pump unit are in separate housing in the rear of the machine, carrying pressure gauge and control valves, in order to keep bending operation in full view of operator at all times. Machine is mounted on skids for moving along length of pipe line during bending operation. □□□

Continued on page 40

EXPERIENCE

builds a line of HYDRAULIC PRODUCTS

Take another look at the pumps pictured above. They're samples of an important, improved, top-quality line: *HP. Hydraulic Products Division* of Clark Equipment Company.

Behind this line is the know-how of five 20-year veterans of the hydraulic business . . . and the backing of a company old in industrial experience and known throughout the world for dependable, high-quality products.

Hydraulic Products pumps, motors, and valves are planned, in light of all this experience, to eliminate your most serious hydraulic component problems. *Quality* and *dependability* are probably the most important gains . . . HP products are built in a plant with all new tooling and the latest in automatic 100% testing. HP products are aluminum . . . compact and light in weight. Every HP product is designed for easy servicing . . . you can, for example, reseal or even rebuild an HP pump in the field without loss of efficiency.

Visit our plant. Write for our catalog or, better still, for immediate information pick up the phone and call us—Benton Harbor WAlnut 6-2133.

hp CLARK EQUIPMENT

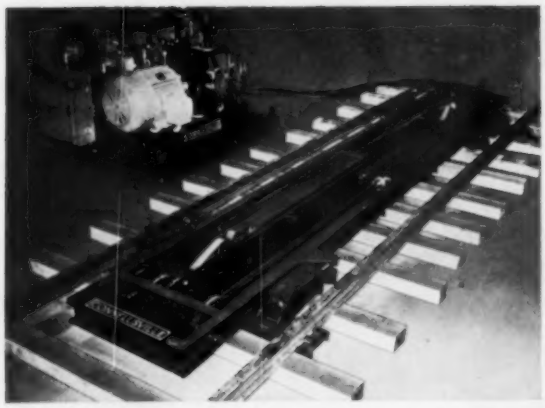
HYDRAULIC PRODUCTS DIVISION
CLARK EQUIPMENT COMPANY
Miller Street Plant
Benton Harbor, Michigan

Circle **31** *on Time-Saver Card*

BRIEFS

FLUID POWER HIGHLIGHTS AT COAL SHOW

Boring its way through the lower reaches of Cleveland's Public Auditorium, the annual Coal Show displayed products for digging coal faster and cheaper. Seen everywhere were hydraulic and pneumatic systems for traction drive, drilling, supporting, and other functions. Here are some examples.

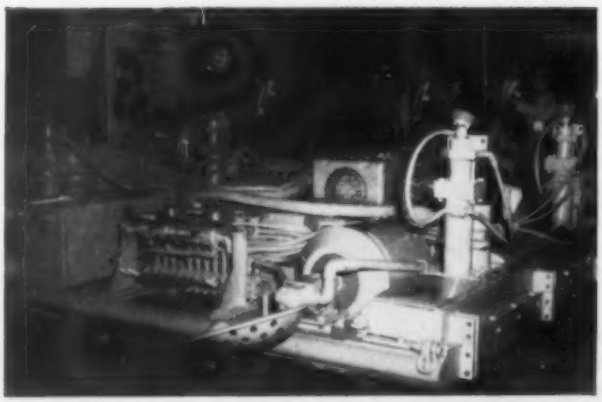


L-SHAPE RESERVOIR—Control valves are mounted on the reservoir on Connellsville's car handling and dumping equipment. Cylinders are installed to eliminate sprockets, pulleys, cables, or chains. Piston rods are in tension to prevent buckling.

JACKING SYSTEM—Self-advancing system developed by Dowty of England has support units released, advanced, and reset by a simple valve control. Support units have hydraulic operating mechanism in base.

CYLINDER TILTS BLADE—Formerly a hand operation, a cylinder now tilts the blade on Caterpillar's bulldozer. Operator controls the cylinder through a foot-actuated linkage to the control valve.

VARIABLE SPEED DRIVE—Two flow control valves control driving motors on this rock duster made by Galis Electric & Machine. Motors drive all four wheels through transmissions and chains.



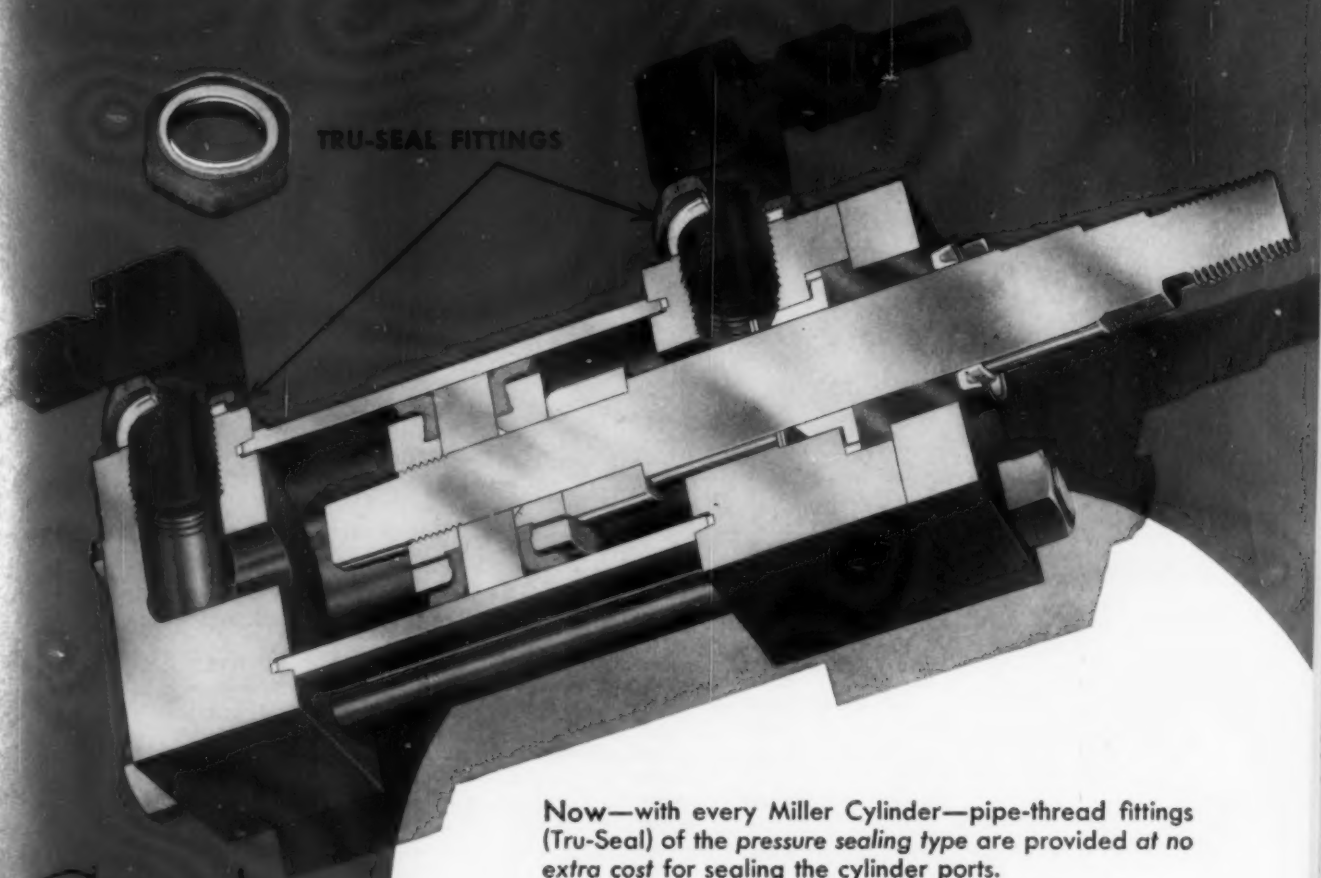
WALKING ACTION—Vertical and horizontal cylinders lift the machine on shoes, slide it along self-contained rails. Fluid motor drives auger feed through transmission, winch, and cable. Compton machine has dual vane pump delivering 8 gpm for 0-5 fpm feed, 21 gpm for 0-130 fpm feed. Auger thrust is 25,000 lb at 1500 psi.

Continued on page 44

Circle 91 ➡

NOW... even the PORTS have seals of the PRESSURE SEALING TYPE!

(J.I.C. Standard H6.2.2)



Now—with every Miller Cylinder—pipe-thread fittings (Tru-Seal) of the *pressure sealing type* are provided *at no extra cost* for sealing the cylinder ports.

Additional advantages of these fittings are:

1. All circuit piping and fittings can be easily positioned.
2. Damage to equipment caused by high tightening torque is completely eliminated (especially on valves, pumps, etc.)
3. Sealing material is Teflon, which is compatible with all hydraulic fluids (J. I. C. Standard H6.2.1)

Specify Miller for Greater Reliability

Engineering Bulletins on Miller Air and Hydraulic Cylinders Available on Request

MILLER FLUID POWER
DIVISION OF FLICK-REEDY CORPORATION

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AIR AND HYDRAULIC CYLINDERS • ACCUMULATORS
COUNTERBALANCE CYLINDERS • BOOSTERS

GD60 AND 80 SERIES

GD100 SERIES

LR20B SERIES

Control gases safely, accurately

TO 15,000 PSI AND 50,000 SCFM WITH VICTOR REGULATORS

You get precise regulation of high pressure gases with large flow rates, because Victor employs gas pressure to control the regulating diaphragm. The result is accurate delivery from 5 to 15,000 psi with inlet pressures to 15,000 psi . . . plus ability to obtain flows in excess of 50,000 scfm at maximum inlet and outlet pressures. Chart below shows operating range of standard models.

MODEL NO.	MAX. INLET PSI	MAX. OUTLET PSI	FEATURES	MAX. FLOW SCFM
GD10	3,600	500	Single adjustment regulator control	250
GD30	2,500	2,500	Load & bleed valve control	400
GD31	3,600	3,600	Load & bleed valve control	600
GD61C	2,500	2,500	Load & bleed valve control	170
GD62C	3,600	3,600	Load & bleed valve control	200
GD65	6,000	6,000	Load & bleed valve control	250
GD65C	7,000	7,000	Load & bleed valve control	250
GD80A	5,000	5,000	Load & bleed valve control	500
GD81A	10,000	10,000	Load & bleed valve control	800
GD86R	10,000	10,000	For remote control only	1,200
GD100R	6,000	6,000	For remote control only	20,000
GD100	6,000	6,000	Load & bleed valve control	20,000
GD200	6,000	6,000	Load & bleed valve control	50,000
GD700	7,000	7,000	Single adjustment regulator control; self relieving	250
SR10	3,600	1,000	Small, spring loaded regulator	4
LR20B	7,000	7,000	Spring loaded regulator; self relieving	2
LR20BSS	10,000	10,000	Spring loaded; stainless steel	2
LV10	7,000	7,000	Loader valve control	15
BPR10	7,000	7,000	Back pressure regulator	2

Operating temperature range: −67°F. to +250°F.

. . . Yours for the asking
Take advantage of Victor's long experience with high pressure gas regulation to help solve your special problems involving flow rates, delivery pressures, corrosive fluids and temperature compensation. Write, wire or phone us today. No obligation.

All models listed are field proved. Most are designed for panel mounting or remote control. They regulate all non-corrosive gases, including oxygen. Stainless steel models available for corrosive gases and pressures above 10,000 psi. For complete specifications, write for Victor High Pressure Regulator sheets.

VICTOR for regulators

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Mfrs. of High Pressure and Large Volume Gas Regulators; welding & cutting equipment; hardfacing rods; blasting nozzles; cobalt & tungsten castings; straight-line and shape cutting machines.

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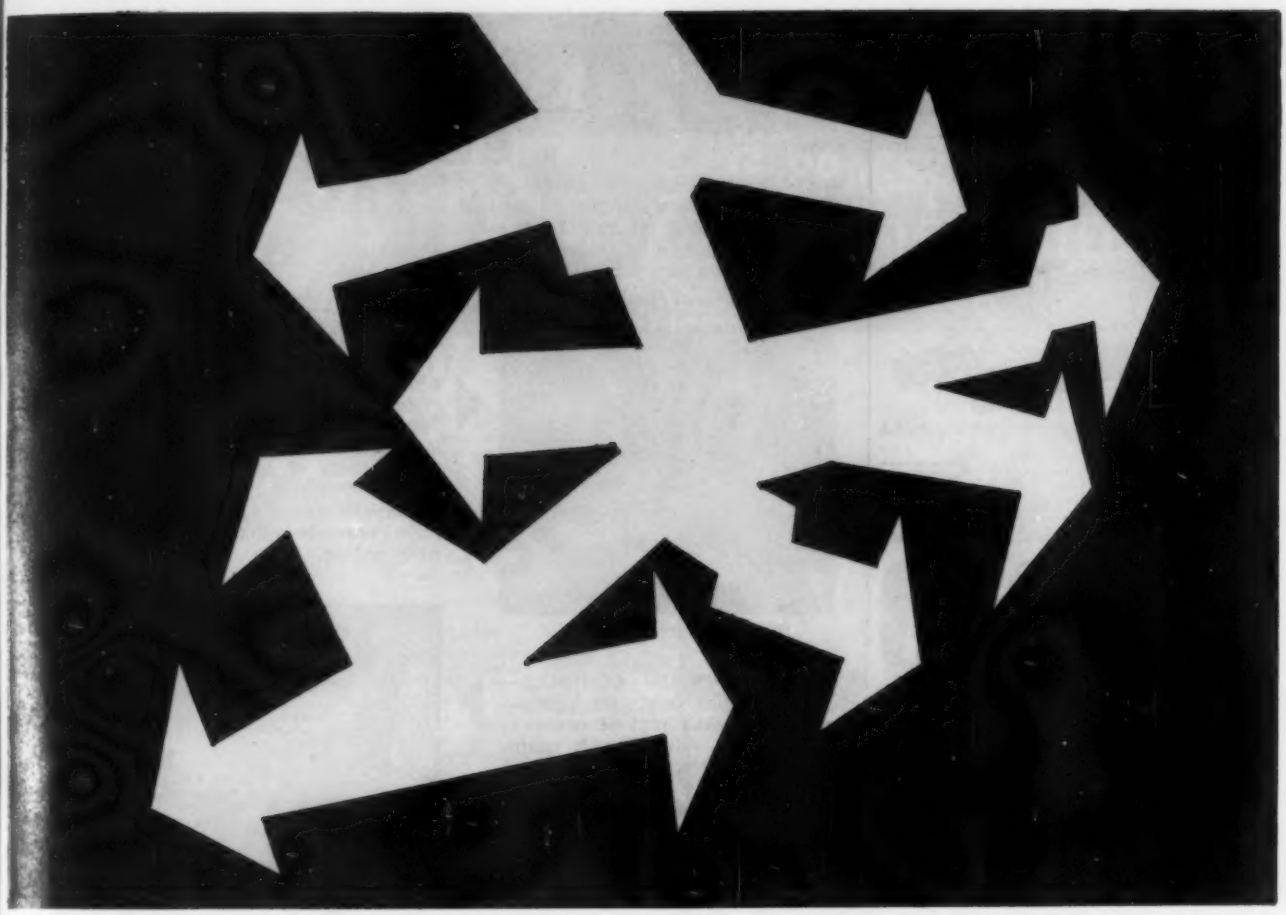
J. C. Menzies & Co., Wholly-Owned Subsidiary



DIRECTIONAL CONTROL absolute control of movement in any direction can only be achieved by hydraulic power.

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Keelavite are solely concerned with industrial hydraulics

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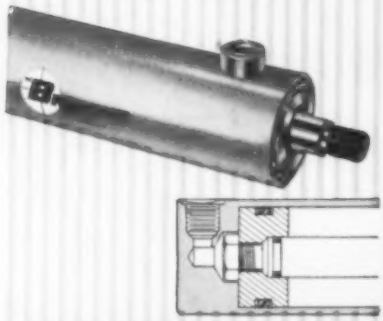
3000 PSI

MAXIMUM QUALITY
MINIMUM COST



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CYLINDER

Save Weight—Space—Cost

Check these advantages:

- Clean, compact design.
- Exclusive "Bruning-ized" bore.
- Extremely wide selection of bores, rod diameters and mounting combinations.
- For both hydraulic and pneumatic applications.
- 3000 PSI operating pressure.
- Rugged, dependable performance.
- Easily adapted to customer specials.
- Premium quality.
- Highly competitive prices.

COMPARE PRICE AND DELIVERY

For original equipment or replacement parts specify Bruning DECCTO cylinders.

Bruning has a complete line of high performance hydraulic and pneumatic couplers, cylinders and check valves.

WRITE FOR FREE BULLETIN
No. 554-18

THE BRUNING COMPANY

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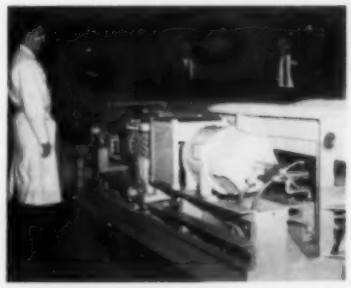
BRIEFS

AIR - MOTOR - DRIVEN DRILL—Hydraulic cylinders position an air-motor-driven drill on this Le Roi equipment. System is powered by 2.8-gpm piston pump at 1500psi.

2-SPEED FLUID MOTOR—Dual gear motor gives speeds of 450 rpm or 180 rpm for roof drilling and bolting. Two fluid motors mounted at front wheels of machine built by Chicago Pneumatic drive through transmissions and chains. Selector valve prevents vehicle movement while drilling.

DUAL HYDRAULIC CONTROLS—American Mine Door's track cleaner can be operated from either side by open center valves which control seven cylinders. Hydraulic operations are raise and lower digger plate, actuate wing plates, manipulate boom and conveyor.



Pressure Vessel Gets Tough Tests Before Use

A series of severe tests were performed on a large pressure vessel before acceptance for use by the government. The vessel, designed for operational pressures of 30,000 psi and test pressures of 45,000 psi, was tested by 80 gauges at critical points in the structure.

More than 1500 readings for strains and stresses were recorded during operation to 45,000 psi and back again.

Designed and built by Lowey-Hydropress of Philadelphia, a division of Baldwin-Lima-Hamilton Corp., the vessel consists of a multi-ring, high-pressure shell which moves in and out of a rigid frame of laminated steel plates.

Effective sealing of the full vessel opening is achieved by an arrangement of a moving seal and hydraulically-actuated locking plates.

Following test results evaluation and a year of normal operation, stress concentration factors at critical sections have been found unusually low. This is due to the initial design being aimed to provide a freely-breathing structure rather than a rigid one, subjected to very high local forces. □□□

PRESSURE CYLINDER withdrawn for loading.

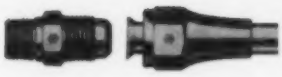
Continued on page 46

WEATHERHEAD

offers one source for all tube fitting needs... a complete line of flared, flareless or pipe...

TUBE FITTINGS of BRASS, CARBON or STAINLESS STEEL

BRASS FITTINGS



S.A.E. 45° FLARE
USED with copper, brass, aluminum, steel and plastic tubing. PRESSURE RATINGS up to 5000 p.s.i. **Sizes: ⅛" to ¾".** Also available in 37° heavy pattern brass. Listed by U.L.; approved by A.G.A. Meets specs of S.A.E. Hydraulic Tube Fittings Standards and A.S.A. and A.S.M.E. codes for instruments and control piping.

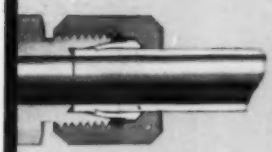
COMPRESSION
USED with copper, brass, aluminum and plastic tubing. PRESSURE RATINGS up to 2000 p.s.i. **Sizes: ⅛" to ¾".** Listed by U.L.; approved by A.G.A. Meets specs of S.A.E. Hydraulic Tube Fittings Standards and A.S.A. and A.S.M.E. codes for instruments and control piping.

SELF-ALIGN®
No flaring, soldering, welding—insert tube and tighten nut. USED with copper, brass, aluminum and plastic tubing. PRESSURE RATINGS up to 2000 p.s.i. **Sizes: ⅛" to ¾".**

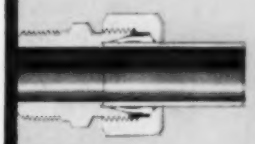
INVERTED FLARE
USED with copper, brass, aluminum, steel, Bundyweld and plastic tubing. PRESSURE RATINGS up to 3000 p.s.i. **Sizes: ⅛" to ¾".** Listed by U.L. Meets specs of S.A.E. Hydraulic Tube Fittings and A.S.A. and A.S.M.E. codes for instruments and control piping.

PIPE
USED with brass or steel pipe. PRESSURE RATING: up to 5000 p.s.i. **Sizes: to 2".** Meets specifications of S.A.E. TPHL Fittings Committee.

FORGED STEEL FITTINGS



"7000" SERIES ERMETO®
U.L. listed. Meets J.I.C. standards. S.A.E. approved "O" Ring boss design. Dryseal pipe thread. Needs no flaring. Available in either carbon or stainless steel. Carbon steel fittings have "Weathercoat" or cadmium-plate finish. PRESSURE RATINGS: up to 10,000 p.s.i. **Size Ranges—⅛" through 2".**

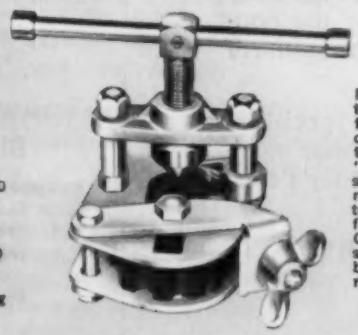


"8000" SERIES ERMETO®
Listed by U.L. for use with hazardous liquids, fuel equipment, refrigeration and gas; meets specs of S.A.E. and J.I.C. hydraulic tube fitting standards. Supplied as standard in cadmium-plated carbon steel and in stainless steel. Requires no flaring. PRESSURE RATINGS: up to 10,000 p.s.i. **Size Range—⅛" through 2".**

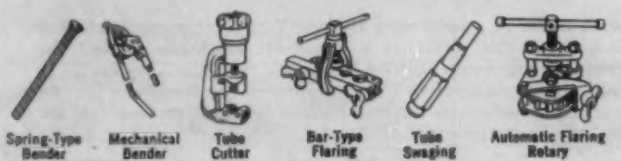
FLARE-TWIN—(2-pc. or 3-pc.)
37° FLARE STEEL TUBE FITTINGS
Listed by U.L. S.A.E. and J.I.C. approved. Used with J.I.C. and other soft steel tubing; also with copper, aluminum, and fully annealed stainless steel tubing. Meets S.A.E. standards for straight thread boss mounting. PRESSURE RATINGS up to 10,000 p.s.i. **Sizes: ⅛" through 2".**

FLARE-TWIN
Made in 3-piece and 2-piece assemblies. 2-piece type offers price advantage. "Weathercote" or cadmium-plate finish.

FAST! EASY! ACCURATE TUBE WORKING TOOLS



New rotary flaring tool for perfect tube flaring. Fast . . . one piece construction. Easier . . . "Dial - Matic" tube size selection. Accurate...tube stop automatically controls flaring diameter. Compact . . . easy to store. Available with burnishing attachment.



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BRIEFS

20 Papers Accepted For Annual NCIH Meeting

Twenty papers have been accepted for the annual meeting of the National Conference on Industrial Hydraulics. Secretary Ray D. Meade presented the preliminary program at a recent executive meeting.

Set for October 22-23 at Chicago's Hotel Sherman, the '59 meeting has been expanded in two areas. Sessions on Materials Forming Machinery and Space Hydraulics will increase coverage of fluid power application.

Five papers are now scheduled for these sessions.

Materials Forming Machinery—(1) "Power Spinning" by Garrett Visser, Midwest Automation, Inc., Minneapolis; (2) "Impact Forming" by J. B. Ottestad, Convair, and (3) "Brains (Electronics) and Brawn (Hydraulics) Without Servo Valves" by Walter P. Hill, Walter P. Hill Co.

Space Hydraulics—(1) "Acceleration Switching Hydraulic Servos in Navy Guided Missiles" by W. Seamone, Applied Physics Laboratory, Silver Spring, Md., and (2) "A Gyroscopic Mass Flowmeter" by Dr. Wilford Roth, Roth Laboratories for Physical Research, Hartford, Conn.

At the general session, John Pippenger will introduce the program: "Looking Ahead — Fluid Power in the 1960's."

This year's conference chairman is R. Q. Sharpe. □□□

Continued on page 48

BRIEF NOTES

NEW HOME FOR NFPA . . . Current headquarters for NFPA is 5595 N. Hollywood Ave., Milwaukee 17. Phone there is WOodburn 2-9950.

FILTER ELEMENT KIT AVAILABLE . . . A filter-element engineering kit for design engineers can now be obtained. Write to Bendix Filter Division, Bendix Aviation Corp., 434 W. 12 Mile Rd., Madison Heights, Mich. The assortment of five, 1" Microbon ribbon-type filter elements can be installed for performance testing and evaluation in air and liquids requiring low-cost, high flow rate, and high efficiency filtration.

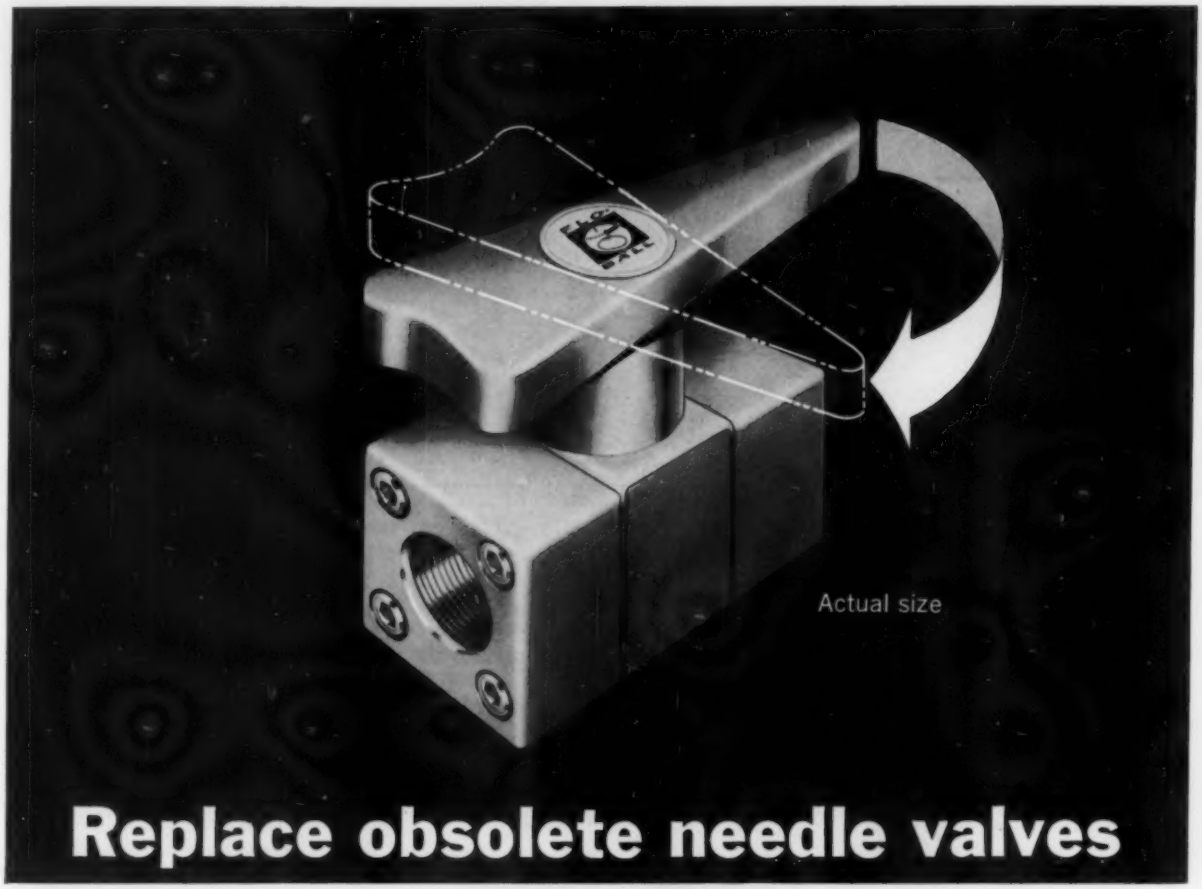
NEW F-R FLUID INTRODUCED . . . Visitors to the annual Coal Show in Cleveland in May saw demonstrations of Shell's 3XF Mine Fluid. It's an inexpensive, fire-resistant emulsion-type hydraulic fluid available for mine equipment use. The fluid requires no modification of existing equipment and is furnished as a concentrate to be mixed with water just before using.

JIC APPROVES WELDED TUBING . . . Use of welded tubing for fluid power systems was approved by the recent meeting of the Joint Industry Conference. An appendix to the revised Standards (complete in this issue) specifies chemical composition, mechanical properties, dimensions, quality, packing and marking, and inspection requirements.

BUSINESS BRIEFS

CHANGE IN NAME . . . Sundstrand Machine Tool Co., became Sundstrand Corporation this spring as a result of shareholder action. The Sundstrand Hydraulic Division has become Sundstrand Hydraulics as part of the changeover. With headquarters in Rockford, Ill., the company manufactures various hydraulic industrial products, aircraft and missile components.

ENTERS HOSE FIELD . . . Dayton Rubber Co., Dayton, Ohio, has entered the industrial hose field. The new line includes air and pressure hoses in a full range of sizes and construction. Product manager is Jack O. Quamme. At present, Dayton is a major supplier of hose for aircraft and missile industries.



Replace obsolete needle valves with the NEW 90° ON-OFF *FLO-BALL*

For 3,000 PSI...

Low torque, instant action . . . a fast 90° turn, requiring just 4 inch-pound torque at 3,000 psi, actuates the valve instantly!

Priced no higher than needle valves!

100% flow efficiency . . . straight-thru ***FLO-BALL*** design has more than twice the flow efficiency of needle valves!

Positive ON-OFF indication . . . large arrow-shaped handle shows valve position at a glance!

Zero leakage . . . Mass Spectrometer tests with Helium prove zero leakage!

Universal mounting . . . can be panel, side, bottom, or line mounted!

Removable flanges . . . damaged flanges can be removed in seconds; no need to replace entire valve!

All stainless steel construction . . . costs no more than old fashioned screw-type valves!

Versatile service . . . ideal for leakproof control of air, vacuum, steam, water, fuels, oils, kerosene, alcohol, and many other fluids.

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Port Styles and Sizes			
NPT		AND10050	
Size	Part No.	Size	Part No.
⅛	715A1	¼	715A2
¼	715B1	⅜	715B2

Other models are available for service with cryogenic and corrosive media. Also special designs for throttling flow control.

Write today for new catalog describing the world's most complete line of precision valves for industrial and military applications.

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BRIEFS

Clark Equipment Forms Hydraulic Division

A hydraulic products division has been formed by Clark Equipment Co. Hydraulic systems manufactured will be for company use and outside sale.

Lauck

Campbell

In the past, Clark has spent $3 million yearly for systems for its line of material handling equipment. An increasing percentage of these systems will be produced by the new division, announced President George Spatta.

In development at the Benton Harbor, Mich. plant are designs suitable for the aircraft, missile, and rocket fields.

General manager of the new division is John Lauck, and sales manager is J. D. Campbell. □□□

DUMPING CLEARANCE OF SEVEN FEET is offered by this 1200-pound capacity hydraulic scrap handler attachment. The Yale Y-18 consists of (a) seven rigid, carrying forks welded to a 48" carriage; (b) four more widely spaced, hydraulically controlled clamping forks which close against the carrying units, and (c) separately controlled hydraulic kick-off forks which sweep material from the carrying surface in dumping. Two, 3" diameter double acting cylinders control action of the hold-down clamp, while a single cylinder powers the kick-off device.

JUST a turn of the end on the adjusting rod and the stroke of this versatile O-M Cylinder is lengthened or shortened to fit the operation. This is accomplished with micrometer accuracy in a moment from the outside of the cylinder without disassembling or unmounting the unit or extra parts. Thus, you get the advantage of a special cylinder with no additional cost.

OTHER ADVANTAGES. Fits where others won't. All-steel construction with bearing surfaces of bronze. Designed right to seal right. Rod has high yield point. Can be disassembled and assembled faster than tie-rod types. Delivers continuous, smooth, dependable power at low or high speeds. Port can be oriented to any position. End plugs are tapped for universal mounting.

Available in a complete range of sizes (1½" to 8" bore) with standard, 2 to 1 or oversize rods. Also full line of mounting brackets interchangeable bore for bore. Immediate delivery on many sizes.

Mail coupon *TODAY* for Bulletin 112 featuring O-M Adjustable Stroke Air and Hydraulic Cylinders.

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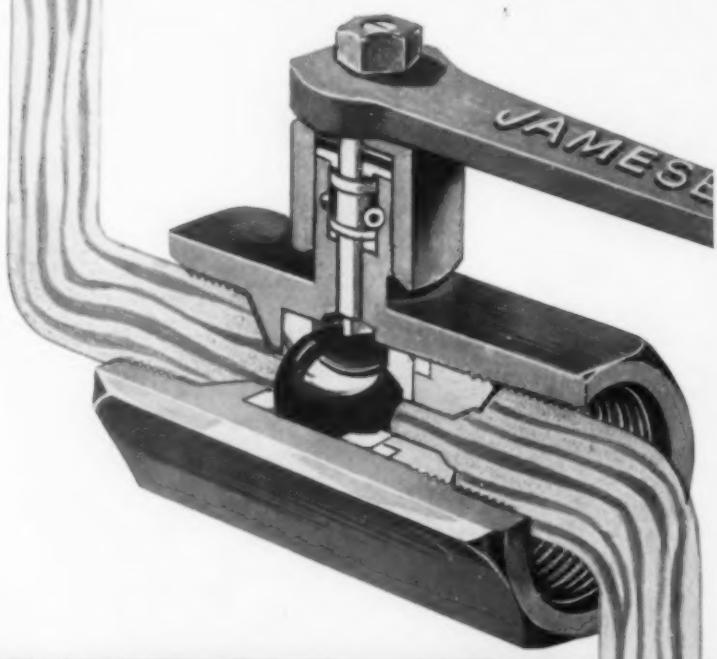
"Double-Seal"™

HIGH-PRESSURE BALL VALVES

STYLE H SERIES

3,000-4,500 p.s.i. Range



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. . . no other valve has these outstanding features

- Unit-body construction
- Positively leakproof
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- Indestructible in service
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- Incomparable size-rating-test-burst performance ratio

—a newly developed and advanced valve design with broad industrial applications, available in eight sizes through 2", with 303 and 316 Stainless Steel or Carbon Steel bodies. Choice of nylon or "Teflon" seats and seals.

Distributors in principal cities.
For further information, write: Data: Style "H" Series

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FUTURE EVENTS

August 10-13: SAE National West Coast meeting, Hotel Georgia, Vancouver, B. C., Canada.

September 14-17: National Farm, Construction, and Industrial Machinery Meeting, Production Forum, and Display. Milwaukee Auditorium, Milwaukee, Wisc.

September 21-25: ISA 14th Annual Instrument-Automation Conference Exhibit, International Amphitheatre, Chicago, Ill.

October 5-10: SAE National Aeronautic Meeting Aircraft Manufacturing Forum, and Aircraft Engineering Display. The Ambassador, Los Angeles, Calif.

October 22-23: 15th Annual National Conference on Industrial Hydraulics, Hotel Sherman, Chicago, Ill.

October 26-28: Annual Fall Meeting, National Fluid Power Association, Statler Hotel, Detroit, Mich.

October 26-28: SAE National Transportation meeting, La Salle Hotel, Chicago, Ill.

October 28-30: SAE National Fuels and Lubricants meeting, La Salle Hotel, Chicago, Ill.

November 2-6: 41st National Metal Exposition & Congress, International Amphitheatre, Chicago, Ill.

December 11: Association of Lift Truck & Portable Elevator Manufacturers, Roosevelt Hotel, New York, N. Y.

Now you can get standard sizes in C/R End Face Seals!

Chicago Rawhide now announces the availability of a complete new line of Standard End Face Seals to meet the widest possible range of sealing requirements. For sizes or conditions beyond the range of Standard End Face Seals, C/R engineers will continue to cooperate with you on special designs. Their experience in sealing applications is unmatched — your assurance of getting the correct seal for the job.

Write for your free copy of this new C/R Bulletin ⟶

Bulletin EF-100 includes complete envelope space data on C/R Standard End Face Seals and mating rings to help you select the correct size for your equipment design:

- Size range table in two series — long and short — from ¾ to 4 inch shaft diameter.
- Size range table on mating rings.
- Typical seal installations for internal and external pressure.
- Special instructions on how to order.

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STANDARD
END FACE SEALS
maximum sealing efficiency in minimum space
• ¾ to 4 inch shaft sizes
• pressures to 500 psi
• temperatures to 500° F.
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• external or internal pressures
2 complete series . . . long and short . . . pre-engineered to meet the widest possible range of sealing requirements. Standard mating rings also available.
Special End Face Seals..
For special sizes and extreme conditions other than those for which the C/R standard end face seal was designed, C/R will continue to develop new seals or recommend existing designs. C/R's years of sealing experience assure you of the right seal for your job.
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Chicago 22, Illinois

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Offices in 55 principal cities. See your telephone book.
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Export Sales: Geon International Corp., Great Neck, New York
C/R PRODUCTS: C/R Shaft and End Face Seals • Sirvene (synthetic rubber) molded pliable parts • Sirvia-Conpor mechanical leather cups, packings, boots • C/R Non-Metallic Gears

Over 30 years of variable volume vane pump experience

CURRENT MODEL Q
PUMP — 5 GPM — 1000 PSI

THOUSAND upon THOUSANDS of RACINE-SECO variable volume vane pumps are serving industry today. A testimonial to the greatness of this principle of pump construction and operation. Today's pumps are designed with the experience of 30 years in a young industry.

In particular, this is the 7th anniversary of the introduction of the 5 GPM Model Q Pump. During these 7 years, *of field application experience*, design changes have been made to improve the efficiency and life of the pump. Buy the pump with built-in experience.

Put this engineering experience and know-how to work for you, too. Write us today. Representation in all principal cities.

RACINE SECO

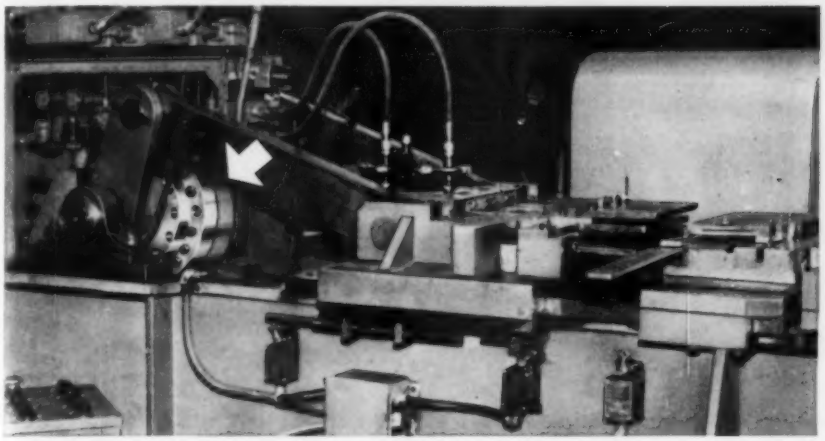
RACINE HYDRAULICS & MACHINERY, INC.
RACINE, WISCONSIN

One Source — One Responsibility for all your hydraulic circuit needs

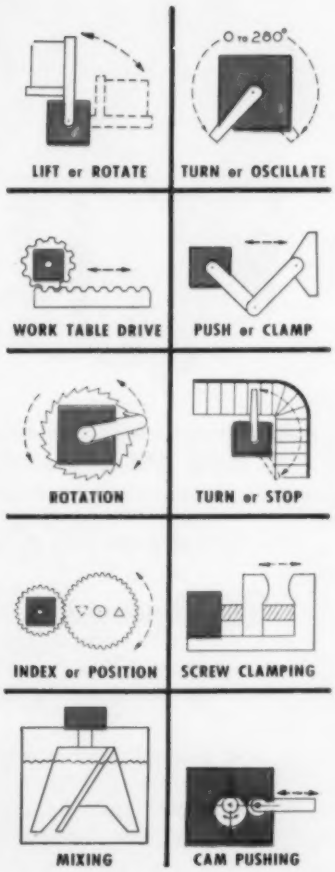
RŌTAC®

EXERTS 60-TON FORCE

. . . *In 1/6th the Space of a Straight-line Actuator!*

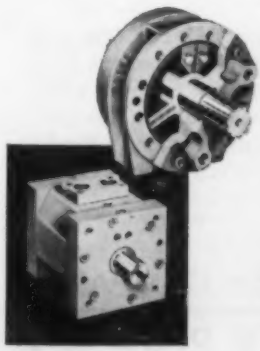


Left: **Every 1½ minutes, a Model HN Rōtac Torque Actuator on this wire-forming machine exerts a 60-ton force on the work through a simple toggle arrangement. Higher torque and higher speed—in a fraction of the space required by a straight-line power unit, control valves and motor—add up to Rōtac efficiency! (Photo courtesy Stubnitz Greene Corp.)** ***Below:*** **These typical Rōtac applications might suggest the answer to your design problem:**



Rōtac Reciprocating Rotary Torque Actuators are designed to do more jobs that cannot be done easily or economically with other devices. **Torque** is instantaneous and uniform through the required arc. **Ratings** range from 100 to 40,000 inch-pounds for standard single-vane models, from 240 to more than 200,000 inch-pounds in double-vane models. **Power source** can be air, oil or other fluids, with operating pressures to 1,000 psi in standard Rōtac units. **Mounting** can be vertical, horizontal or at any angle, and RN models can be safely manifold mounted. **Rotation or oscillation** (to 280° in single-vane models) can be stopped, started, slowed down or speeded up. **Application** is unlimited; among hundreds of uses are mobile installations, machine tool and various light and heavy industrial applications. **Construction** conforms to J.I.C. standards, and to Ex-Cell-O's own high requirements for precision, long life and low maintenance. **Special designs** available for unusual applications, military and aircraft use. **Delivery** of a wide range of standard catalog models is fast. See your local Rōtac Representative or write direct.

59-R-2



FREE DESIGN DATA BOOK—20 PAGES

Contains everything you'll want to know about RŌTAC—How it works • Control • Typical applications and special uses • Installation details • Dimensions • Torque ratings.

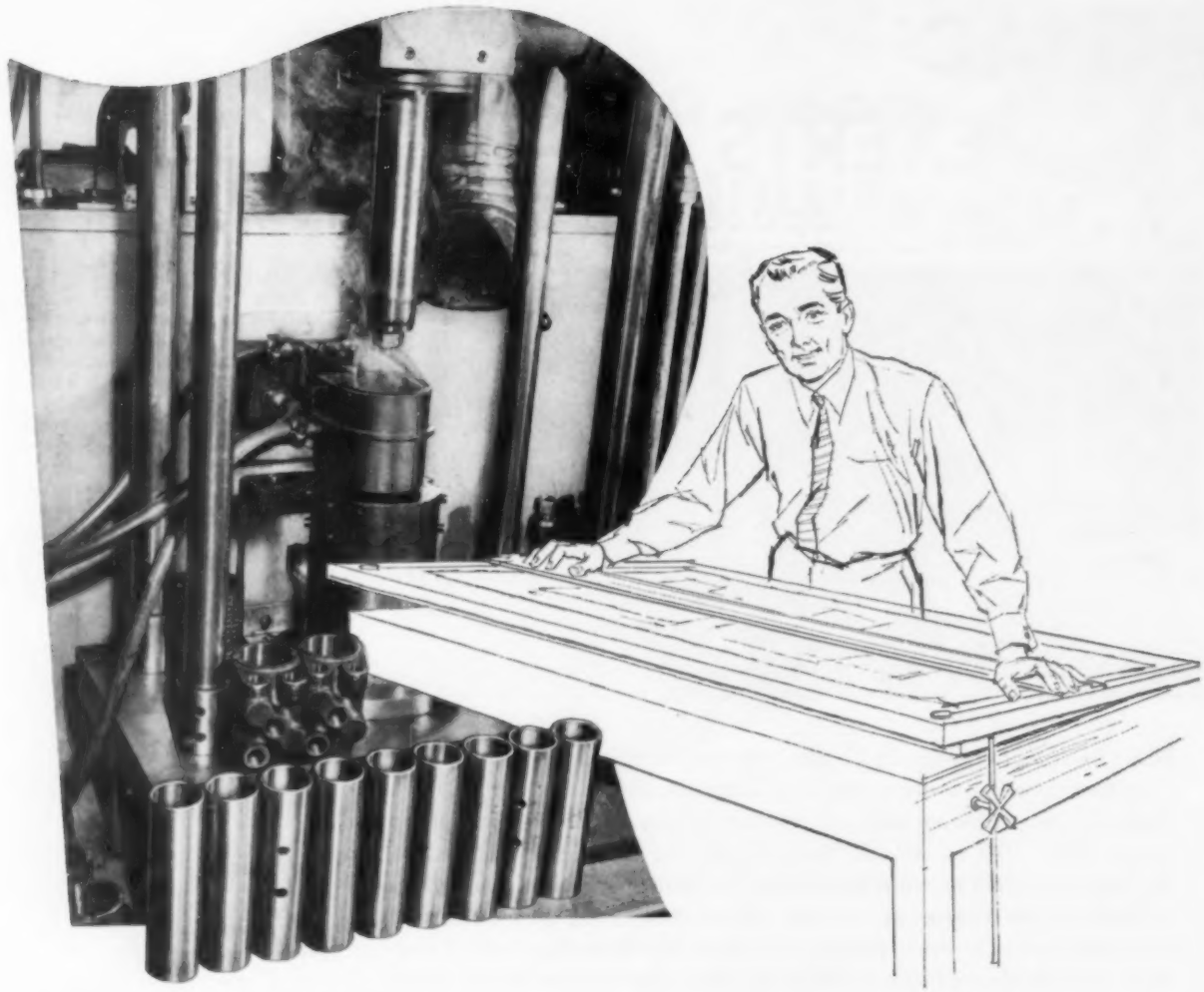
EX-CELL-O CORPORATION

Greenville Plant, 945 E. Sater St., Greenville, Ohio

XLO

EX-CELL-O FOR PRECISION

EX-CELL-O PRECISION PRODUCTS INCLUDE: MACHINE TOOLS • GRINDING AND BORING SPINDLES • CUTTING TOOLS • RAILROAD PINS AND BUSHINGS • DRILL JIG BUSHINGS • TORQUE ACTUATORS • THREAD AND GROOVE GAGES • GRANITE SURFACE PLATES • AIRCRAFT AND MISCELLANEOUS PRODUCTION PARTS • DAIRY EQUIPMENT



"B&W Welded Tubing with special smooth ID finish keeps my fabrication problems to a minimum!

As a design engineer for hydraulic applications, I find that B&W Welded Carbon Steel Mechanical Tubing with special smooth ID finish offers outstanding benefits. The finished condition in which it comes to our plant reduces costs by eliminating a number of fabricating operations."

The uniform finish of this type of tubing means that for many hydraulic applications it can be used "as received" from the mill—eliminating such operations as grinding and polishing. Continuous quality control through every manufacturing operation—with ultrasonic testing supplementing accepted methods of inspection—makes sure that you get tubes matched to your end-use application. Ask Mr. Tubes, the B&W specialist—he can help you with any tube problem—or write for bulletin TB-428. The Babcock & Wilcox Company, Tubular Products Division, Beaver Falls, Pa.

B&W

THE BABCOCK & WILCOX COMPANY

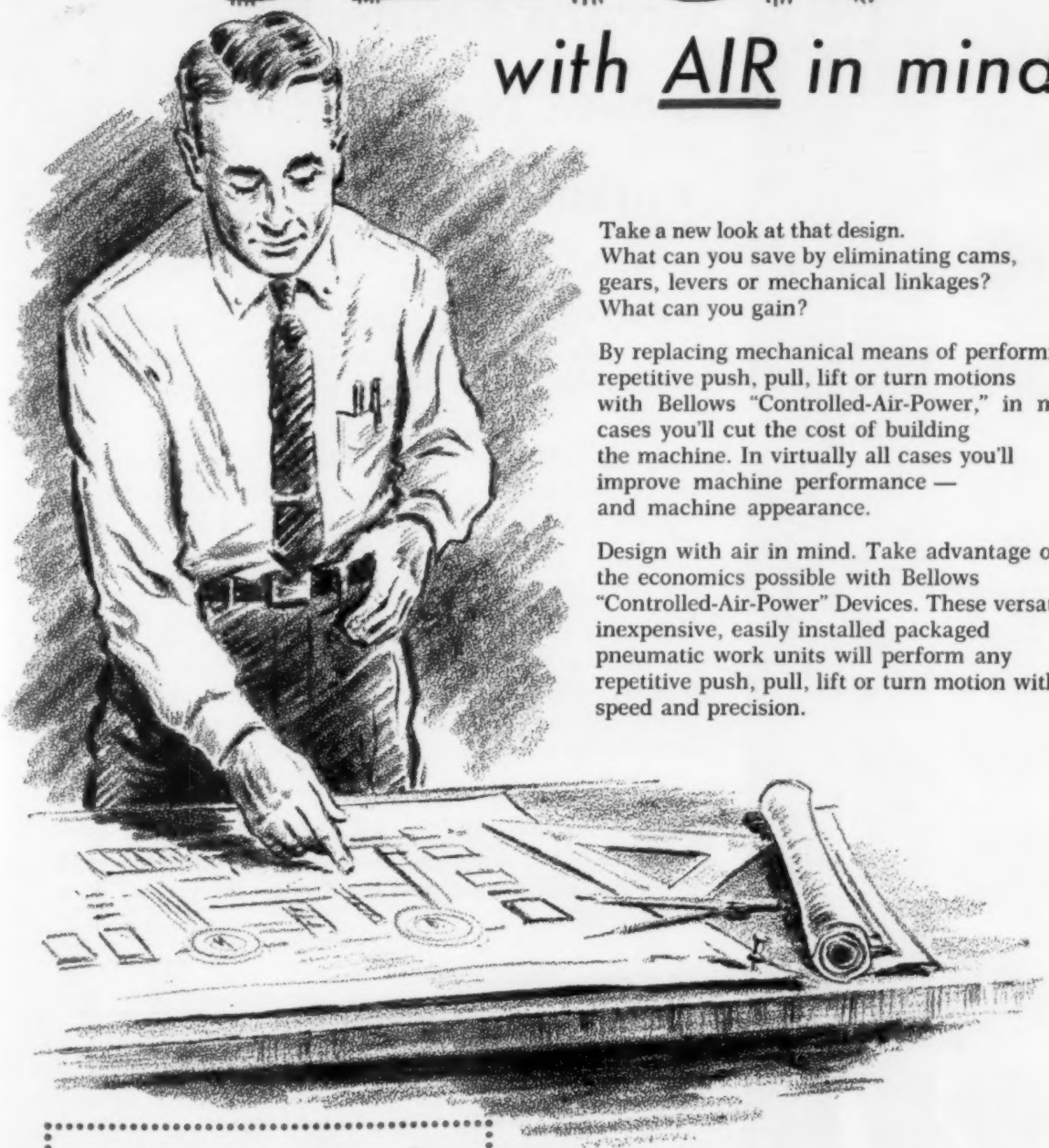
TUBULAR PRODUCTS DIVISION

TA-8009-M2

Seamless and welded tubular products, solid extrusions, seamless welding fittings and forged steel flanges—in carbon, alloy and stainless steels and special metals

DESIGN

with AIR in mind



Take a new look at that design.
What can you save by eliminating cams, gears, levers or mechanical linkages?
What can you gain?

By replacing mechanical means of performing repetitive push, pull, lift or turn motions with Bellows "Controlled-Air-Power," in most cases you'll cut the cost of building the machine. In virtually all cases you'll improve machine performance — and machine appearance.

Design with air in mind. Take advantage of the economics possible with Bellows "Controlled-Air-Power" Devices. These versatile, inexpensive, easily installed packaged pneumatic work units will perform any repetitive push, pull, lift or turn motion with speed and precision.

READ THIS STORY—

"The Place of the Bellows Air Motor in Original Equipment Design."

This new 14 page booklet will be of help to any design engineer.

Write Dept. AH 759,
The Bellows Co., Akron 9, Ohio

In Canada: Bellows Pneumatic Devices of Canada, Ltd., Toronto, Ontario

The Bellows Co.

DIVISION OF INTERNATIONAL BASIC ECONOMY CORPORATION (IBEC)

AKRON 9, OHIO

893-B

Creative editorial makes reading more worthwhile

APPLIED HYDRAULICS & PNEUMATICS is edited exclusively for designers, engineers and production men in more than 30 industries using fluid powered machinery.

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Reading APPLIED HYDRAULICS & PNEUMATICS each month keeps you abreast of the latest happenings in the world of fluid power. It's designed to help men like yourself do a better job.

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Specify the

T-J Spacemaker

for longer, more efficient cylinder service

With Extras . . . At No Extra Cost

1. METAL PISTON ROD SCRAPER—protects rod packing, cylinder bore and rod surface by removing all foreign particles.
2. NEW "SUPER" CUSHION for air or METALLIC SELF-ALIGNING MASTER CUSHION for oil.
3. HARD CHROME PLATED CYLINDER BORES AND PISTON RODS for greater protection and reduced wear.
4. ONE PIECE PISTON assures better alignment, longer bearing and packing life.
5. FORGED SOLID STEEL HEADS throughout entire line.
6. PILOTED PACKING GLAND with extra long bearing for additional strength and support to piston rod.
7. NO TIE-RODS TO STRETCH—gives you 360° port rotation . . . less space used . . . full strength.
8. STREAMLINED DESIGN . . . operating pressures to 200 PSI, air; 1,000 PSI oil, non-shock.

You too—can reduce replacement expenditures—lower maintenance costs with the T-J Spacemaker cylinder line. Designed and engineered for ruggedness, and accuracy of operation, the Spacemaker assures longer, uninterrupted operation.

The T-J Spacemaker eliminates tie-rods, gives greater strength, saves space . . . and reduces costs in all push-pull operations. Immediate delivery in a complete range of styles and capacities . . . air or oil. Write for Bulletin SM 155-4, today. The Tomkins-Johnson Company, Jackson, Michigan.

T-J TOMKINS-JOHNSON

RIVETORS . . . AIR AND HYDRAULIC CYLINDERS . . . CUTTERS . . . CLINCHORS

STEEL LINES FOLD LIKE AN ACCORDION
Typical of diverse swivel joint applications, newly designed Chiksan Discpak joints are installed on the steam lines of a platen press. This new type swivel joint, designed for hot gas and steam, allows inexpensive packing replacement without removing swivel joint from line.

WHEN *design*
DICTATES
METAL LINES . . .

SOLVE LINE FLEXING PROBLEMS

with CHIKSAN SWIVEL

Chiksan swivel joints allow metal lines to be flexed in predetermined travel arcs, eliminate hose rupture, reduce maintenance and replacement costs.

Where tight bends in pressure hose make wide loops necessary, Chiksan swivel joints, conversely, permit compact placement of lines. When used with hose, Chiksan swivel joints shorten hose lengths and also lengthen hose life by minimizing tight bend and torsional fatigue.

Chiksan swivel joints are available from stock in a wide range of materials, temperatures, and pressures to meet practically every design requirement. Chiksan swivel joint packing units are designed for specific services. For example, packings have been developed to efficiently handle non-inflammable hydraulic fluids. Write today for catalog and name of nearby sales engineer.

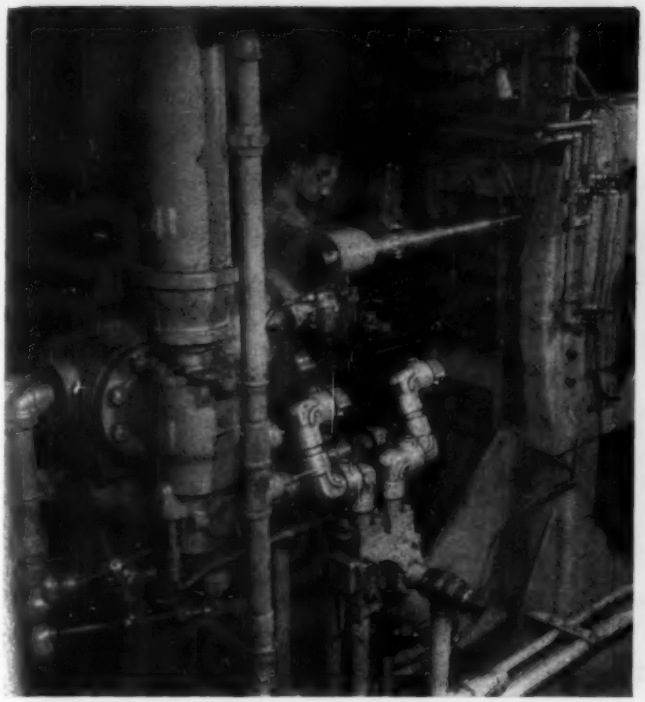
LONG SERVICE LIFE ➤
Chiksan swivel joints deliver years of service with only occasional maintenance attention. All-steel hydraulic lines on Flash-Butt welder, shown at right, allow lines to shift as machine is adjusted to handle various work.

A SUBSIDIARY OF FOOD MACHINERY AND CHEMICAL CORPORATION

fmc CHIKSAN

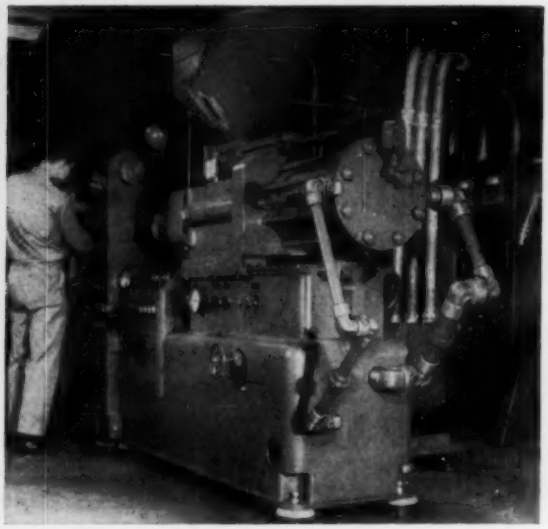
CHIKSAN COMPANY—BREA, CALIFORNIA • CHICAGO 5, ILLINOIS • NEWARK 2, NEW JERSEY

Well Equipment Mfg. Corp. (Division), Houston 1, Texas • Subsidiaries Chiksan Export Company • Chiksan of Canada Ltd



NO HOSE BURST DANGER HERE...

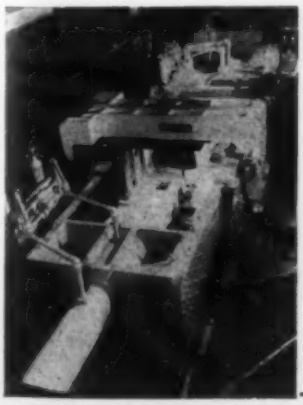
Critical lines take on a new measure of safety with all-steel flexible units replacing pressure hose. These all-metal swivel jointed lines shown on a die casting machine above, eliminate damaging hose ruptures, and reduce fire hazard, fluid loss and setup time by 75%.



PRESSURE? TEMPERATURE? CHIKSAN MEETS THE NEED...

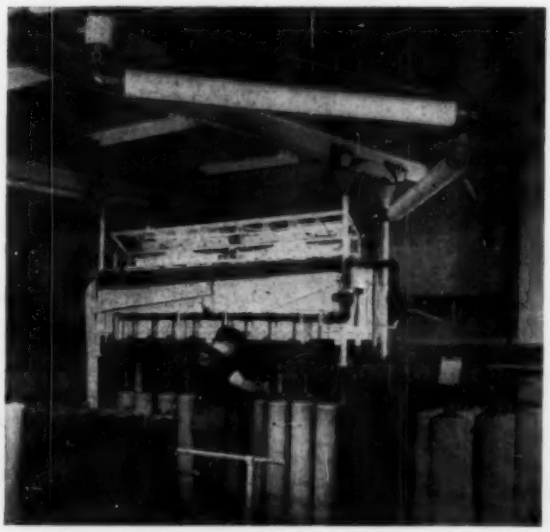
Over 2,000 different types, styles and sizes in a variety of temperature and pressure ratings are available to meet your design needs. This plastic injection molding machine, above, uses two different sizes of Chiksan swivel joints on its hydraulic lines.

JOINTS



NO LIMIT ON LINE DESIGN

Free swiveling action in 1, 2 and 3 planes permits design of compact lines to meet any requirement. This overhead line in service at a water softener regenerating plant permits shift from one setup of tanks to another for faster handling of tank regeneration.



#58-31

CHIKSAN COMPANY
330 NORTH POMONA AVENUE, BREA, CALIFORNIA

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Name_____ Company_____

Title_____ Address_____

City_____ Zone_____ State_____

USEFUL LITERATURE

For your free copy of publications reviewed, fill in the reader service card

PRESSURE PLUGS

Set flush to within half a pitch. Ends hazard of protruding plugs and permits smaller clearances, Photos, drawings, complete specification information for these Levl-Seal plugs. Recommendations for tapping and seating torques for steel and aluminum applications presented in tables and charts. *Standard Pressed Steel Co., Jenkintown, Pa.*

Circle **400** on Time-Saver Card

HYDRAULIC TUBING

Of alloy A-286 cold drawn for high temperature uses to 1300 F where high strength is required. Alloys iron, nickel, and chromium. Oxidation resistance equals stainless steel at 1800 F. Tests lasting more than 500 hrs. at 1300 F show high corrosion resistance. Good at sub-zero temperatures. Physical properties, fabrication, minimum and maximum walls given in Analysis Memo 114. *Superior Tube Co., Norristown, Pa.*

Circle **401** on Time-Saver Card

PRESSURE GAUGES

Incorporate extreme safety features, extensive cycling, high pressure or overload shock, vibration to 2000 cps. Product photos with dimension drawings, specifications, and ordering instructions. *Rochester Manufacturing Co., Rochester, N.Y.*

Circle **402** on Time-Saver Card

HEX SOCKET CAP SCREWS

Now come with larger heads. They can carry larger loads without indenting. Diameters from ¼" in '80 Series now are 1½ times body diameter, providing more under-the-head bearing surface in many sizes. Bulletin G-25 contains tables of dimension standards, comparisons of head diameter, bearing surface, tensile load to indent soft steel. Four graphs of research results show relation of depth of impression in various materials to tensile load, tightening torque, and tension on screws. *The Allen Mfg. Co., Hartford, Conn.*

Circle **403** on Time-Saver Card

AIR MOTOR

Combination cylinder-and-solenoid actuated air control valve with built-in speed controls. Avail-

able with 4 mounting styles in 5 bore sizes from 1¼ to 4½". Bulletin 215 covers specifications, dimensions for all bore sizes. Special section shows accessories and explains how motor works. *Hannifin Company, A Division of Parker-Hannifin Corp., Des Plaines, Ill.*

Circle **404** on Time-Saver Card

WELDED STEEL TUBING

For hydraulic application. Used to reduce, or eliminate completely, honing operations. Available in a complete range of sizes and gages. Charts show available sizes. Ordering information. Many application photos. *The Formed Steel Tube Institute, Cleveland.*

Circle **405** on Time-Saver Card

AIR-OVER FAN MOTORS

For quiet operation. Air cools motor. May use smaller, lighter motor for desired hp capacity. Optional foot or flange mountings, suitable for vertical or horizontal mounting. Ratings from 1 to 125 hp. *Louis Allis Co., Milwaukee.*

Circle **406** on Time-Saver Card

THINLINE MOTOR

For limited space. Rated from 1 to 5 hp. in dripproof and totally enclosed constructions. Product photos with parts designated, description of features, chart of interchangeable flange dimensions, and data on all models. *General Electric Co., Schenectady.*

Circle **407** on Time-Saver Card

SERVO VALVE CONTROLS

To provide remote, hand lever control of servo valves. Panel mounted unit operates through machined sector gear and pinion, potentiometers, synchros and differential transformers. Product photo, specifications, dimensioned drawings, and application photos for preset units included in Bulletin 36301. *Servocontrol, A Division of The Oilgear Co., Milwaukee.*

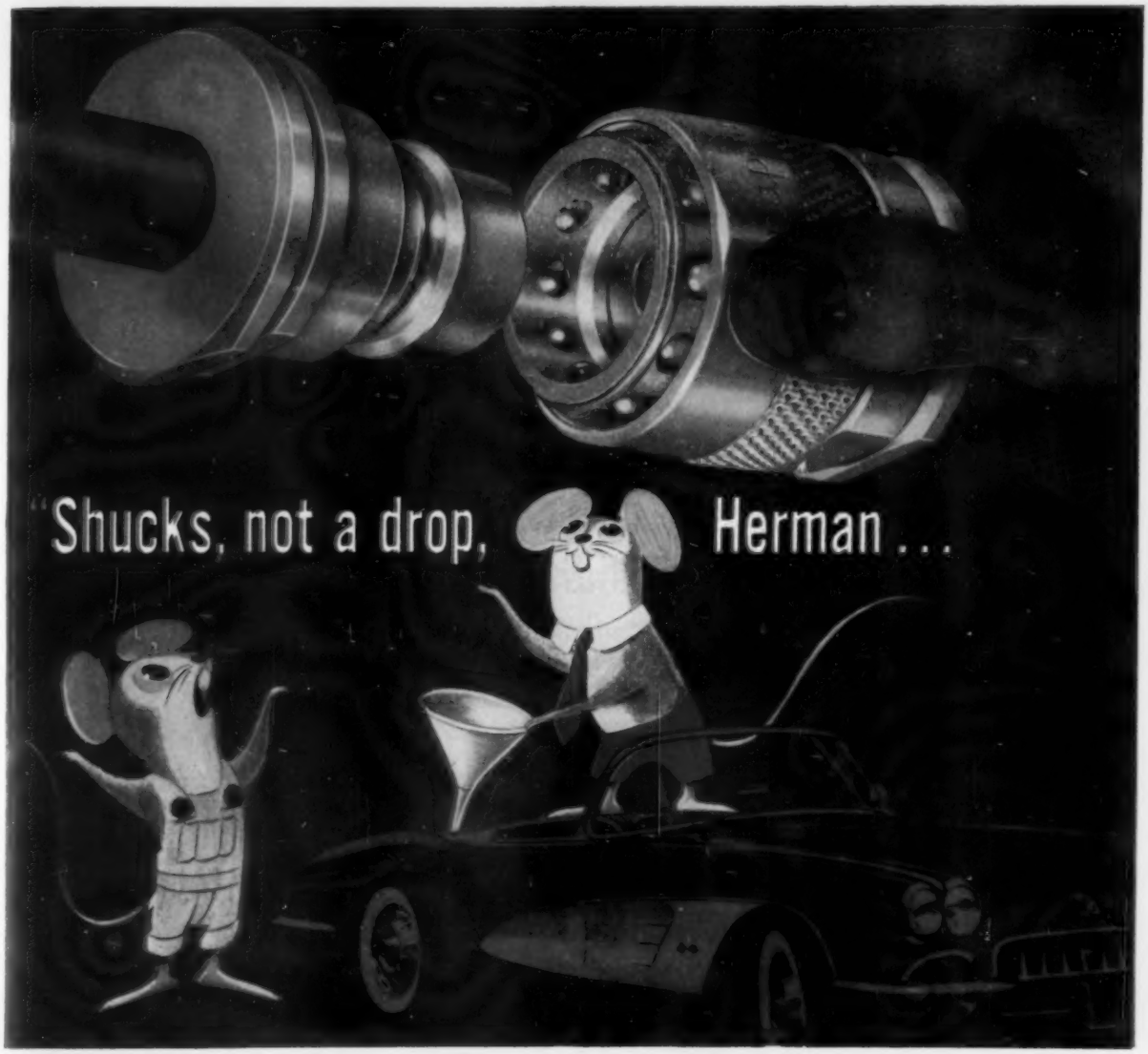
Circle **408** on Time-Saver Card

OIL SEALS

Listed by size, design in 50-page specifications manual. Many product photos of spring-loaded, springless, combination, extended case, and external types. Book contains application data, suffix codes, design and installation data, drawings. *Federal-Mogul Service, Division of Federal-Mogul-Bower Bearings, Inc., Detroit.*

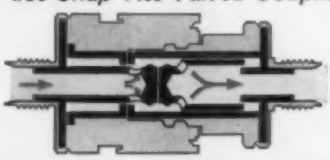
Circle **409** on Time-Saver Card

For more reviews of FREE LITERATURE turn to page 156

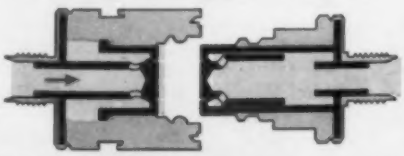


. . . it's a no-spill valved coupling by Snap-Tite!"

To use Snap-Tite Valved Coupling:



CONNECT—Full flow instantly



DISCONNECT—Stop flow instantly

The 15 Series valved coupling automatically snaps off the flow of the most volatile fluids when disconnected—with no leakage.

Snap-Tite's 15 Series valved coupling contains valves in both sections. Thus, the only fluid lost is that which clings to the outer metal surfaces. This coupling meets military specifications and can be used with fuels and other fluids to 3000 psi working pressure and 400°F. Sizes: ¼", ½", ¾", 1" in 6061T6 aluminum anodized; ⅜" in steel (electroless nickel plated), and 6061T6 aluminum.

Snap-Tite can provide the right valved coupling—with quick off-on action wherever coupling or shut-off is required—for most any use, most any fluid.

For more information, write for Snap-Tite Catalog #15. Snap-Tite representatives in all principal cities.

★ Snap-Tite

UNION CITY 1, PA.

ST-59-03

NEW PRODUCTS

Components, tools and equipment for fluid power systems. For more information fill in and mail post card bound in this issue.

PUMP UNIT
. . . has two stages

Features: For presses with considerable ram movement at fairly low pressure and finish cycle at high pressure. Two pumps provided, driven from opposite ends of

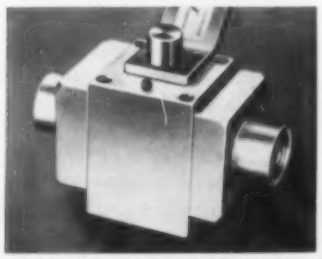
motor. Automatic unloading valve is built between pumps. When pressure reaches set figure, delivery from low-pressure pump is bypassed to supply tank.

Specifications: At 1440 rpm, low pressure pump capacity is 12 gpm; high pressure, 1½ gpm. Motor has 2½ hp.

Hydraulics & Pneumatics Ltd.
Wolverhampton, England
Circle **300** *on Time-Saver Card*

2-WAY-DIRECTIONAL VALVE
. . . has low pressure drop

Features: Low pressure drop, high flow capacity, positive seal. Hydraulic balance in valve assures



low turning torque. No external leakage even at double rated pressure. Each port individually attached to body. You may select, change, service ports without special tools.

Specifications: For 0-3000 psi operating pressures. Pressure drop of 25 psi at 20 gpm in ½" size. Less than 5 lb. force turning torque at 3000 psi. Weighs 2 lb., 7 oz. Ports with ¼, ⅜, or ½" dry seal pipe threads.

Sarasota Precision Products Inc.
Sarasota, Fla.
Circle **301** *on Time-Saver Card*

PIPE JOINT SEALER
. . . made from Teflon

Designation: Thred-Tape

Features: Seals many threaded connections under diverse conditions. Handles many fluids, fuels. Can be

used on various surfaces. Prevents seizing, galling. Self-lubricating, makes extremely tight connections. Never hardens, so joints can be easily disassembled.

Specifications: In ½x288" rolls in plastic box.

Crane Packing Co.
Morton Grove, Ill.
Circle **302** *on Time-Saver Card*

ADAPTER FITTING
. . . for straight thread port seals

Features: Adapter allows use of "No-Swing" metal-to-metal port hole fitting in existing pipe threaded holes in pumps, manifolds, valves, cylinders. Adapter has standard male pipe thread at one end, female straight thread socket on other. It locks into pipe threaded port for leak-proof connection.

Flodar Corporation
Cleveland, Ohio
Circle **303** *on Time-Saver Card*

FLEXIBLE TUBING
. . . is lightweight

Designation: Synflex -N3-

Features: For OEM replacement in air and hydraulic lines. Precision tolerances, lower notch sensitivity, resistance to internal or external abrasion.

Specifications: Group I low-pressure tubing to 1500 psi; Group II to 2500 psi. Both have O.D. of ⅛, 3/16, ¼, 5/16 and ⅜". Shipped in 500′ coils and bagged to preserve moisture content.

Synflex Products Division
Samuel Moore & Co.
Mantua, Ohio
Circle **304** *on Time-Saver Card*

AIR, HYDRAULIC CYLINDERS
. . . for heavy-duty use

Features: Extra-long bronze rod bearing provides maximum rod stability, resistance to side-leading deflection, even with rod fully extended. Seal cartridge replaced without disassembling cylinder. Removable port adapters permit easy cylinder assembly replacement.

Teflon wear strip on piston prevents metal-to-metal contact between piston and bore.

Specifications: Wide range of bore sizes. Choice of six mounting types —foot, clevis, pivot (front or rear), adjustable trunnion, or threaded nose. Rated at 200 psi air and 500 psi hydraulic.

Valvair Corporation
Akron, Ohio
Circle **305** *on Time-Saver Card*
Continued on page 64

MARVEL Synclinal FILTERS

For Dependable Protection on HYDRAULIC EQUIPMENT

SUMP TYPE
(Cutaway)

Hydraulic Oils MUST BE CLEAN!

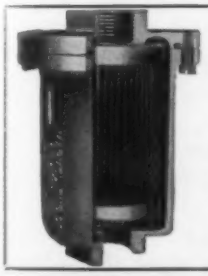
**to Protect Equipment—
Increase Production—
Reduce Maintenance**

PRODUCTION ENGINEERS and MAINTENANCE MEN whose job it is to keep production machinery operating at peak efficiency are specifying Marvel Synclinal Filters on all new equipment and standardizing with Marvel's throughout their plants.

**OVER 900
Original Equipment
Manufacturers**

of hydraulically actuated and other equipment utilizing low pressure liquid circulating systems, who have recognized the superiority of Marvel Synclinal Filters, are installing them as standard equipment.

LINE TYPE (cutaway)



IN-LINE FILTER

Handles up to 25 G.P.M. of hydraulic oil at very low pressure drop. Monel wire cloth filtering media is available in mesh sizes from 30 to 200. Cartridge is easily removed for cleaning.

A SIZE FOR EVERY NEED

Marvel Synclinal Filters are easy to install in sump or on line preceding pump. Both sump type and line type models are available in capacities from 5 to 100 G. P. M. Monel mesh sizes range from coarse 30 to fine 200.

EASY TO CLEAN

Another outstanding feature of Marvel Synclinal Filters is the fact that they can easily be disassembled, thoroughly cleaned and reassembled in a matter of minutes. Thus—"down time" for filter maintenance is reduced to the absolute minimum. Line type operates in any position and may be serviced without disturbing pipe connections.

IMMEDIATE DELIVERY

Catalogs contain complete engineering data and dimensional charts making it easy to select a filter for your specific requirements and get Immediate Delivery.

MEET
J. I. C.
STANDARDS

For further information, write, wire, phone or use coupon below

MARVEL ENGINEERING COMPANY
**7227 N. HAMLIN AVE.,
CHICAGO 45, ILLINOIS
Phone: JUNIPER 8-6023**

Without obligation, please send me complete data on Marvel Filters, as indicated: (AH-7)

- ☐ Catalog #108—For Hydraulic Oils, Coolants, Lubricants
- ☐ Catalog #200—For Fire-resistant Hydraulic Fluids (Aqueous Base)
- ☐ Catalog #400—For Fire-resistant Hydraulic Fluids (Synthetic)
- ☐ Catalog #301—For Water

Name ..... Title .....

Company .....

Address .....

City ..... State .....

NOW AVAILABLE

STRATOFLEX

FLARED TUBE TYPE ELBOW FITTINGS AND ASSEMBLIES

For confined space installations where hose fittings of minimum dimensions are required

For complete information, write for Bulletin S-4 today.

Installation of hose assemblies in a confined space has long been an industry problem. To solve this problem, Stratoflex has developed a flared tube series of elbow hose fittings and assemblies.

Use of these Stratoflex assemblies eliminates the need for combinations of fittings and elbow adapters.

- Form tubing used for fabrication of fittings to allow uniform flow.
- Fittings available for medium and high pressure applications and for transmission of all fluids.
- All fittings are quality steel, quality controlled in manufacture.

SFS-9

STRATOFLEX Inc.

P.O. Box 10388 • Fort Worth, Texas
Branch Plants: Los Angeles, Fort Wayne, Toronto
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New York, Philadelphia
Pittsburgh
San Francisco, Seattle
Toronto, Tulsa

Circle **128** on Time-Saver Card

NEW PRODUCTS

OILTIGHT PRESSURE SWITCH

. . . to 5000 psi

Designation: Bulletin 836, Type T

Features: For heavy-duty industrial application to 5000 psi. Calibrated range scale and indicator

show operating pressure. A visible trip indicator shows when contacts operate. Range adjustment for operating and reset pressure. High contact pressure held to point of switchover. Meets NEMA 12 requirements.

Specifications: Bellows used in 5 low-pressure ranges to 500 psi, piston design for systems to 5000 psi. Piston units withstand surge pressures to 10,000 psi.

Allen-Bradley Co.
Milwaukee, Wis.

Circle **306** on Time-Saver Card

NEEDLE VALVE

. . . has tight shut-off

Designation: Model 816

Features: Uses renewable glass-filled Teflon seat to assure tight shut-off with fluids from vacuum

Continued on page 66

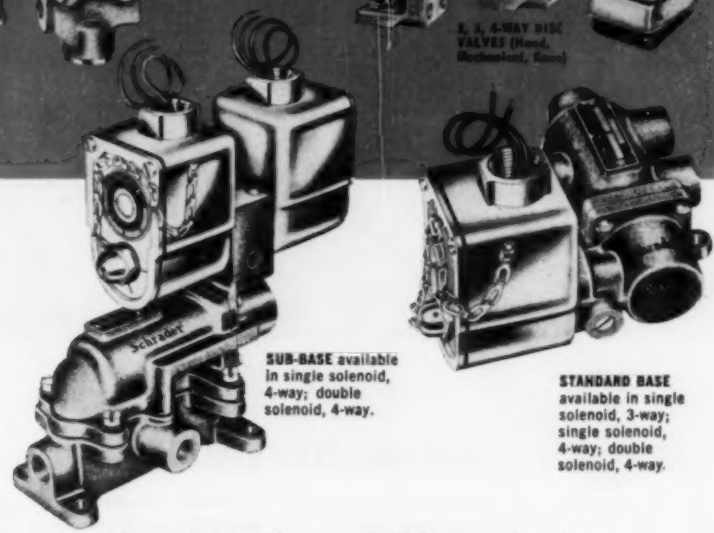
ALL THESE... *full lines from Schrader...*

2 and 3-WAY VALVES (Roller Lever)
2 and 3-WAY VALVES (Angle Lever)
2 and 3-WAY VALVES (Hand Lever)
2 and 3-WAY VALVES (Hand Lockdown)
3-WAY SINGLE SOLENOID VALVES
4-WAY DOUBLE OR SINGLE SOLENOID VALVES (Sub Base)
4-WAY VALVES (Hand, Lockdown)
4-WAY STANDARD OR SUB BASE VALVES (Pilot Operated)
4-WAY DOUBLE OR SINGLE SOLENOID VALVES (Standard)
DISC VALVES—PIPED EXHAUST TYPE (Hand, or Mechanical Operated)
4-WAY VALVES (Foot, Lockdown)
2 and 3-WAY PILOT VALVES (Timed or Fixed, Normally Open or Normally Closed)
2, 3, 4-WAY DISC VALVES (Hand, Mechanical, Knee)
4-WAY VALVES (Foot, Spring Return)
NEW DELAYED BLAST VALVE

AND NOW...

NEW JIC SOLENOID AIR VALVES

..... that meet and exceed JIC specifications



SUB-BASE available in single solenoid, 4-way; double solenoid, 4-way.

STANDARD BASE available in single solenoid, 3-way; single solenoid, 4-way; double solenoid, 4-way.

New JIC Solenoid Valves are compact, rugged, fast-and-easy to install. Roomy junction boxes fit space requirements with 90° rotation. Can be operated in case of current failure, by hand. Safe, recessed override button prevents accidental operation. Electrical system completely sealed against dust, oil.

Schrader's complete line of air valves allow you a freer hand in planning air circuits for your applications. Besides almost unlimited choice of size, style and actuation method, you get these extras in every Schrader valve you buy:

- All parts are designed for maximum air flow, longest service life; simplicity of replacement; interchangeability.
- Schrader Valves feature tough, practical design, precision construction, and are individually tested to full ratings.
- Performance has been proved by years of use in hundreds of plants. All Schrader Valves can operate with Schrader (JIC) Square End Cylinders perfectly.

Use the full Schrader line to do your air control selecting. Your Schrader distributor can help you pinpoint what you need. For more data write:

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Division of Scovill Manufacturing Company, Incorporated
456 Vanderbilt Avenue, Brooklyn 38, N. Y.

Schrader®
a division of **SCOVILL**

QUALITY AIR CONTROL PRODUCTS

NEW PRODUCTS

to 6000 psi. Removing handle and lock nut provides easy panel mounting. Fine pitch regulating threads and taper point on stem give excellent metering qualities, eliminate pressure surge when opening valve. Can overhaul valve without removing from line.

Specifications: Stainless steel construction with Teflon "O" rings and black plastic handwheel. Standard ports are female pipe NPT or female tubing AND 10050.

Dragon Engineering Co., Inc.
Norwalk, Calif.
Circle **307** *on Time-Saver Card*

CONTROL VALVE . . . for many operations

Designation: E. C. Mark II

Features: Valve can be operated by hand, foot, solenoid, hydraulic power, air cylinder, or push knob. Design allows for quick conversion from one operation to another. Has standard components, is easily ad-

justable for wear. Reversible seat for double life. Interior is easily cleaned. Each valve may be withdrawn as complete unit from its port and, with removal of a single clip, all parts can be removed.

George Ellison, Ltd.
Birmingham, England
Circle **308** *on Time-Saver Card*

2-STAGE HYDRAULIC PUMP . . . for 10,000 psi

Designation: Vanguard

Features: Consists of gear pump for low-pressure stage, 5-cylinder axial-piston pump for high pressure. Driven by universal motor of 1⅛ hp. Variety of valves, controls,

accessories available for mounting. All wearing parts made of tool steel.

Specifications: Delivers 600 cu. in. of oil/minute at 100 psi to 50 cu. in. at 10,000 psi. Weighs 45 lb. Reservoir capacity is 2 gal., with 1¼ gal. of usable oil. Motor to 12,000 rpm, needs 60/50 cycle, and can be mounted in any of 4 positions on cover plate.

Owatonna Tool Co.
Owatonna, Minn.
Circle **309** *on Time-Saver Card*

Continued on page 68

BHEW
Hydraulic Cylinders

- Basic Designs
- Specific Adaptations
- Superior Quality
- Application Engineering

BHEW'S 3000 PSI SERIES GENERAL-PURPOSE CYLINDERS, designed around component parts but custom-built to *your* specifications, are available in a variety of mountings, in sizes 1½" through 6", with adjustable or non-adjustable rod ends or without rod ends. These are rugged cylinders for OEM.

• Self-adjusting "V" packed rod glands • "U" cup seal on pistons • Honed steel barrel, high tensile hard chrome-plated rods • Packings available for high and low temperature extremes, most non-inflammable fluids.

Production parts save you money, do the job better! BHEW basic cylinders can easily be modified to fit your *specific* product applications. You benefit from production economies; you get custom-built cylinders.

Let's discuss your design and application problems —

FREE!

Write today for Hydraulic Cylinder Engineering Reference data — 78 dimensional basic designs for general-purpose and special-purpose double-acting and single-acting cylinders. SAVE TIME.

BENTON HARBOR ENGINEERING WORKS, INC.
622 Langley Avenue St. Joseph, Michigan

Circle **21** *on Time-Saver Card*

Now...in handy, concise form

Design Data and Application Hints on J-M Moulded Packings

Here's a "must" for your reference file—Johns-Manville's helpful, new Moulded Packings brochure. Designed to offer you complete engineering details on packings for hydraulic and pneumatic applications in handy, condensed form, this booklet is packed with the data you need most at every stage of planning and design.

In this compact handbook you'll find data on Johns-Manville Packings for pistons and rods—including cups, Uneepac® Rings, V-Rings and Sea® Rings, Cumpac®, and Conepac. Data on pressure and temperature ranges and information on packing materials are also included.

Easy-to-read drawings show you complete packing and stuffing box details and information on follower ring designs. Operating characteristics and required accessories are spelled out to assist you in evaluating each packing for your application.

MAIL COUPON TODAY for your free copy of this informative brochure.

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JOHNS-MANVILLE JM PRODUCTS

Johns-Manville, Box 14, New York, N.Y.
Please send me your new, free brochure on Moulded Packings, PK-126A.

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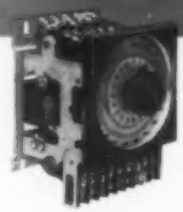
Title_____
Company_____
Address_____
City_____
Zone_____ State_____

Count Control
COMPONENTS
FOR AUTOMATING INDUSTRIAL PROCESSES

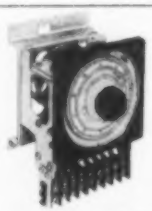
featuring adjustable count · automatic reset · 10 ampere switches



model HZ4
MICROFLEX RESET COUNTER

Use to control an operation for a preset number of counts. Has spring reset to "0." Dial ranges 19, 400 and 1,000 counts.

Ask for bulletin 720.



model HZ200
ADD-SUBTRACT COUNTER

Add-Subtract counter — operates from ADD pulses which trip switch at maximum limit — and SUBTRACT pulses which trip switch at "0" limit.

Ask for bulletin 740.

model MT
STEP SWITCH

Use for sequence control from pulses — 19 contacts — 60 cycle coil-break out cam lugs.

Ask for bulletin 780.

model HZ6
MICROFLEX REVOLUTION COUNTER

Use to control an operation as a function of mechanical movement — drive shaft can be mechanically connected to machine, spindle, conveyor, etc.

Ask for bulletin 730.

model HM
MULTIFLEX (Multiple Circuit) TIMER

Use for sequence control of 1 to 7 circuits. With shaft drive for mechanical connection to an external drive mechanism.

Ask for bulletin 130.

Write us regarding your count problem. Services of Sales Engineers in 25 district offices are available without obligation. Address Dept. AH-759.

EAGLE SIGNAL COMPANY

A Division of the Gamewell Company · Moline, Illinois

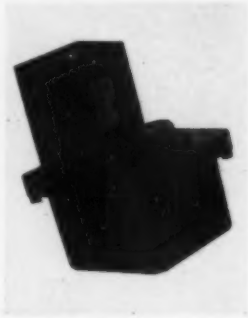
Circle **42** on *Time-Saver Card*

NEW PRODUCTS

SERVO CONTROL VALVE . . . for 1500 psi

Designation: Model SS102

Features: Rugged and simple. Single-stage, uses powerful torque motor to position a 3 or 4-way



valve spool. Motor coils vary with circuit. LVDT pickoff can be used to give top system response and flexibility.

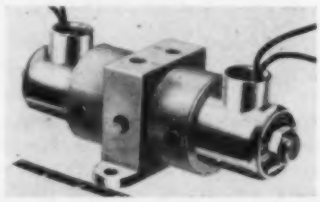
Specifications: Supply pressure to 1500 psi, flow to 6 gpm with 500-psi valve drop. Power input 5 watts. Internal leakage 0.2 gpm.

Hydraulic Controls Co., Inc.
Newton, Mass.

Circle **310** *on Time-Saver Card*

4-WAY SOLENOID VALVE . . . is corrosion-proof

Features: Only 2 internal moving parts and completely protected solenoid coils. Coils will not overheat over long periods. Long life may be extended by inserting 2 new one-piece valve plungers. Re-



placement made without disturbing rigid plumbing.

Specifications: Valve either bottom drilled for manifolding or tapped for standard connection of ⅛ or ¼ NPT.

Airmatic Valve, Inc.
Cleveland, Ohio

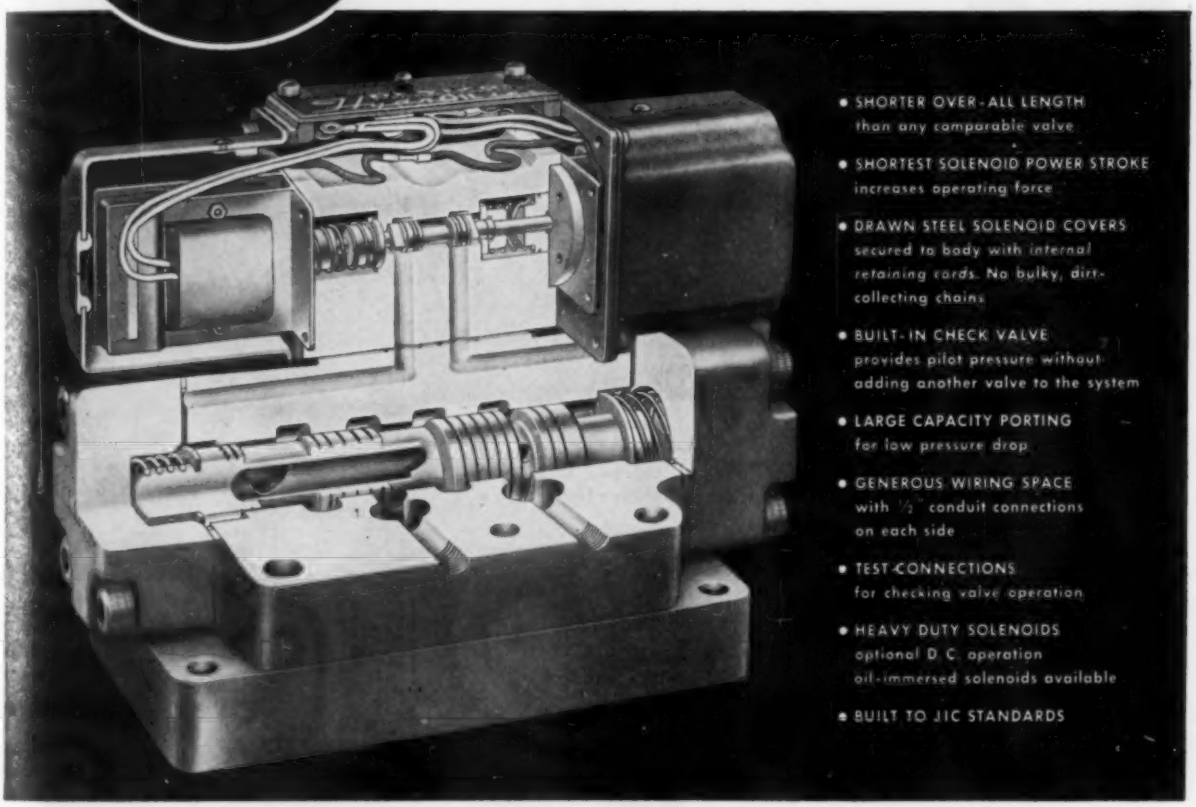
Circle **311** *on Time-Saver Card*

Continued on page 70

NEW from DENISON

4-WAY VALVES

Pilot-operated, solenoid-controlled for hydraulic systems up to 5000 psi



- SHORTER OVER-ALL LENGTH than any comparable valve
- SHORTEST SOLENOID POWER STROKE increases operating force
- DRAWN STEEL SOLENOID COVERS secured to body with internal retaining cards. No bulky, dirt-collecting chains
- BUILT-IN CHECK VALVE provides pilot pressure without adding another valve to the system
- LARGE CAPACITY PORTING for low pressure drop
- GENEROUS WIRING SPACE with ½" conduit connections on each side
- TEST CONNECTIONS for checking valve operation
- HEAVY DUTY SOLENOIDS optional D.C. operation oil-immersed solenoids available
- BUILT TO JIC STANDARDS

SHOCKLESS HYDRAULIC CONTROL for any directional control requirement is assured with Denison's new line of 4-Way Valves.

Here are *more reasons why* the exceptional design versatility of these new 4-Way Valves is important to Hydraulic Engineers—

1. Provide fast, rapid-cycle directional control of hydraulic flows up to 30 gpm.
2. Operating pressures range up to 5000 psi for both ¼" and ¾" valve sizes.
3. Operate in any porting and positioning combination.
4. Solenoid-operated ¼" valve capacity—5 gpm.
5. Pilot-operated, solenoid-controlled ¾" valve capacity—30 gpm.
6. Choice of spool types and spool positioning provides unlimited combinations for a wide range of applications.
7. Adjustable pilot chokes available for smooth spool reversal.
8. Interchangeable parts simplify service and model changes in the field.
9. Easily modified for operation on internal or external pilot pressure by rotating solenoid valve 180°.

DESIGNERS ENGINEERS!

Send for Bulletins VD-7, VD-8 and 240-B

for full details write

DENISON ENGINEERING DIVISION
American Brake Shoe Co.
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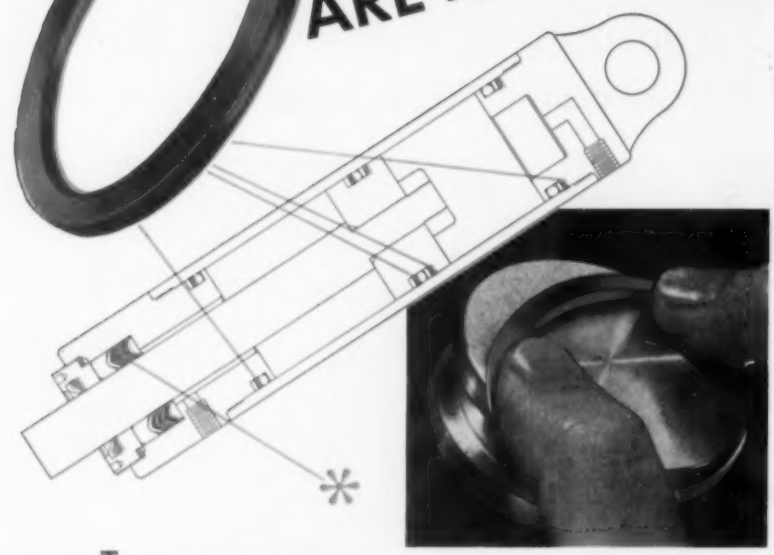
DENISON HydrOILics

HYDRAULIC PRESSES • PUMPS • MOTORS • CONTROLS

ALL BACK-UP WASHERS ARE NOT ALIKE

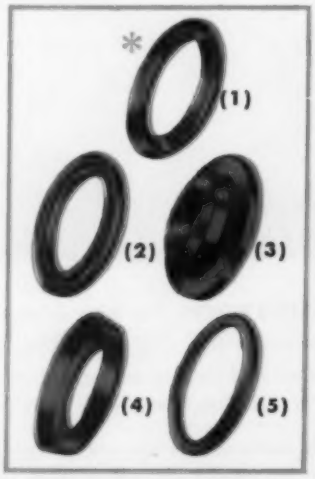


This photograph shows Marsh No. 612 back-up washers being slipped into position. The washers s-t-r-e-t-c-h manually, or with production tooling, over pistons and SNAP BACK to original size. Allows quick installation of piston into cylinder without danger of pinching.

MARSH No. 612 *Thermo* Leather non-extrusion washers have many superior features . . . used in supporting O-rings and V blocks in cylinders and tube fittings.

- **Rubberlike stretch with unaided dimensional recovery into groove.**
- **Synthetic rubber impregnant impervious to ALL hydraulic fluids.**
- **Sealing: air—petroleum base oils —synthetic fluids (water soluble and insoluble) — transmission fluids—solvents.**
- **Operating temperatures: —65° F. to 212° F. plus.**

For toughness unmatched, giving maximum protection against nicking by dirt and grit . . . with low friction and a minimum cold flow . . . try the Marsh No. 612 back-up washers. Available to all commercial and military dash numbers with the more popular sizes in stock.



(1) VEE PACKING • (2) U PACKING • (3) FLANGE PACKING • (4) CUP PACKING • (5) NON-EXTRUSION or BACK-UP WASHERS

Marsh impregnated Thermo Leather packings are custom engineered to individual specifications . . . to fit special temperature ranges . . . to meet specific pressure requirements.

ENGINEERING AND CONSULTING SERVICE — Laboratory Test Reports available on sealing fire-resistant fluids. Write for your free copy today.

C·W·MARSH COMPANY

MAIN OFFICE AND FACTORY: MUSKEGON, MICHIGAN

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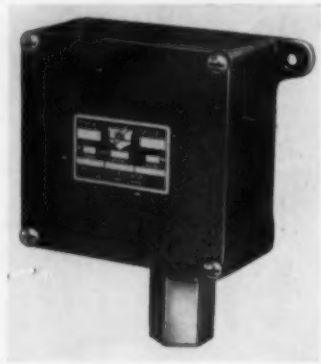
Circle **89** on *Time-Saver Card*

NEW PRODUCTS

PRESSURE SWITCHES . . . to 1700 psi

Designation: Models 670, 680
Features: Increase range of Type J11 series from 500 to 1700 psi.



Bellows are stainless steel with brass connections.

Specifications: Model 670 from 50-1000 psi; Model 680 from 100-1700 psi. Both have top bellows pressure of 3500 psi.

United Electric Controls Co.
Watertown, Mass.
Circle **312** *on Time-Saver Card*

ROTARY PISTON PUMP . . . for 2500 psi service

Designation: Type 29

Features: Rotor, revolving on stationary ported valve, carries seven radially disposed bores, each containing a piston. Each piston is carefully lapped into bores to ensure high volumetric efficiency.

Specifications: Variable delivery, and fixed delivery models. On one model idling pressure can be varied by hand control from 500-2500 psi.

Hydraulics & Pneumatics Ltd.
Wolverhampton, England
Circle **313** *on Time-Saver Card*

For more NEW PRODUCT reviews turn to page 146

Circle **139** ➡

NEW... adjustable 3/4" Deceleration Valve

Simplifies Cam Design, Cuts Set-up Time, Eliminates Need for Special Valve Spools

These Features are Important to You:

- Controlled deceleration regardless of flow rate
- Reduces set-up time—eliminates experimenting with cam shapes
- One valve can handle all applications from 5 to 25 gpm giving greater flexibility
- Regulates initial deceleration pressure—eliminates wasted spool movement
- Can be used for applications to 60 gpm without malfunction
- Includes adjustable by-pass needle valve
- Available with or without check for reverse free flow
- Threaded ports or subplate mounting

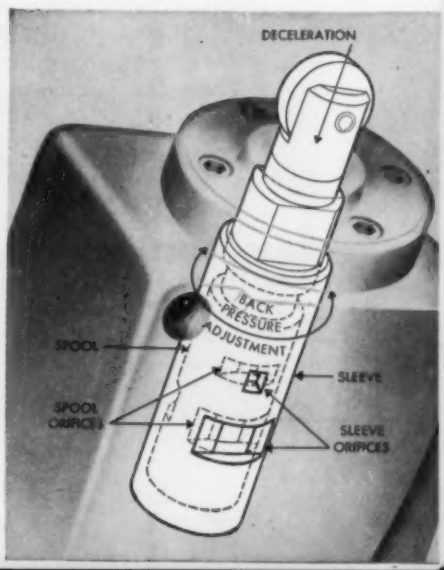
TYPICAL USES:

1. Converting rapid traverse motions to slow, controlled feeds.
2. Rotary indexing operations. Will control deceleration and permit creep to accurate final position.
3. Straight-line transfers. Deceleration control gives smooth stop without excess movement of part being transferred.

Write for installation drawings No. 214322 and I-214323.

Orifice size (through spool and sleeve) is made larger or smaller by rotation of sleeve. Adjusting screws on the face of the valve rotate the sleeve to the required orifice opening. Deceleration stroke length remains unchanged. No special cam shape is required for valve spool travel.

Patent Pending.



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DIVISION OF SPERRY RAND CORPORATION

Machinery Hydraulics Division

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8276

ENGINEERS AND BUILDERS OF OIL HYDRAULIC EQUIPMENT SINCE 1921

Now available on all Parker-Hannifin

STRAIGHT THREADS FOR LEAK-PROOF

Industry's new standard as published in J. I. C. Recommendations (April, 1959) and S. A. E. Standards (1959 Handbook)

Why accept less?

Parker-Hannifin now offers a new standard *at no extra charge*—high-pressure hydraulic components with straight thread port connections* for O-ring type fittings. This new standard—assuring a leak-proof and drip-free seal—is the most logical engineering approach to the problem of hydraulic circuit connections. The Joint Industry Conference Recommendations now state:

"Fittings that incorporate separate synthetic or metal-to-metal seals, or seal with pressure *should* be equipped with Unified National Fine (UNF) straight thread port connections."

And the Society of Automotive Engineers' 1959 Handbook states:

"The S.A.E. straight thread 'O'-ring boss is the preferred port for use in hydraulic devices."

Both support this new standard—and the U. S. Navy Bureau of Ships in MS16142 (SHIPS) has adopted the S.A.E. Straight Thread Boss Design as their straight thread standard for use in hydraulic and air systems in Naval ships. Such extensive support is understandable. The Parker-Hannifin straight thread port connections combine a built-in pressure sealing device with a rigid mechanical connection. This contrasts with the loose connection of a "backed-off" pipe thread and a relatively weak auxiliary sealing device.

Straight thread fittings and port connections are not a proprietary product or design. Although developed by Parker-Hannifin, they were immediately made available to the fluid power industry on a completely open basis.

They have been thoroughly field tested. In the severe service on mobile hydraulic equipment, today more than 6 out of 10 of the port connections are of the straight-thread type.

Now machinery builders and users alike are turning to this proved method of port sealing. Pipe threads for high-pressure hydraulic applications are fast becoming obsolete as more and more leading manufacturers recognize these advantages of straight threads in their production equipment:

No more wedging action with resulting distortion and breakage due to over-tightening ...

No more messy pipe dope and the danger that it will infiltrate the hydraulic system ...

No more leaks because of temperature changes or high shock conditions ...

No more failures of costly auxiliary seals due to weak, imperfect threads that fit on thread run-out.

Why accept less? Next time you order high-pressure hydraulic components, specify Parker-Hannifin with straight thread port connections and fittings ... you'll get leak-proof sealing—industry's recommended standard.

**Mobile equipment spool type control valves are all supplied with straight threads. Other components are still available with dry-seal pipe threads.*

HANNIFIN COMPANY
545 S. Wolf Road, Des Plaines, Illinois

Parker FITTINGS AND HOSE DIVISION
17325 Euclid Avenue, Cleveland 12, Ohio

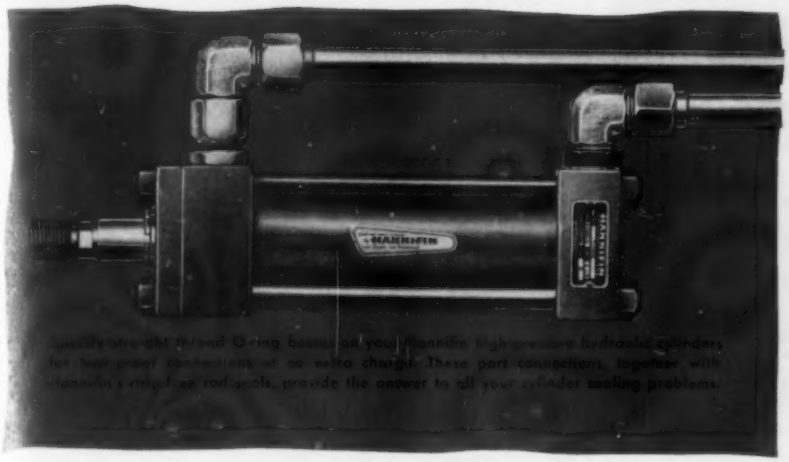
Parker SEAL COMPANY
10567 Jefferson Blvd., Culver City, California

Parker HYDRAULICS DIVISION
17325 Euclid Avenue, Cleveland 12, Ohio

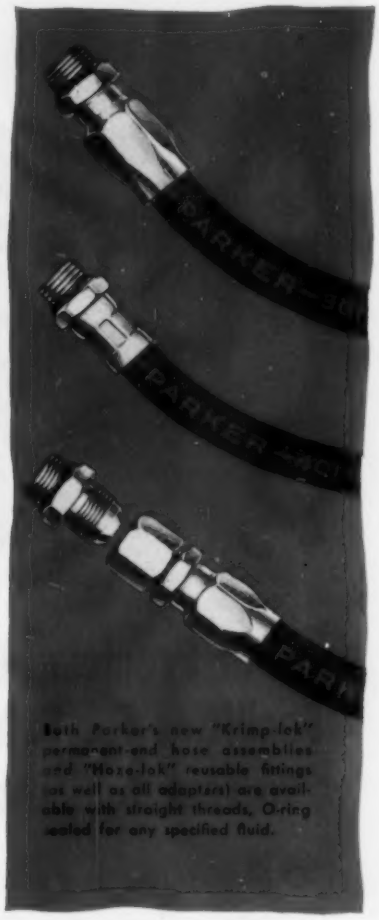
4 DIVISIONS OF PARKER-HANNIFIN CORPORATION

high-pressure hydraulic components

PORT CONNECTIONS...

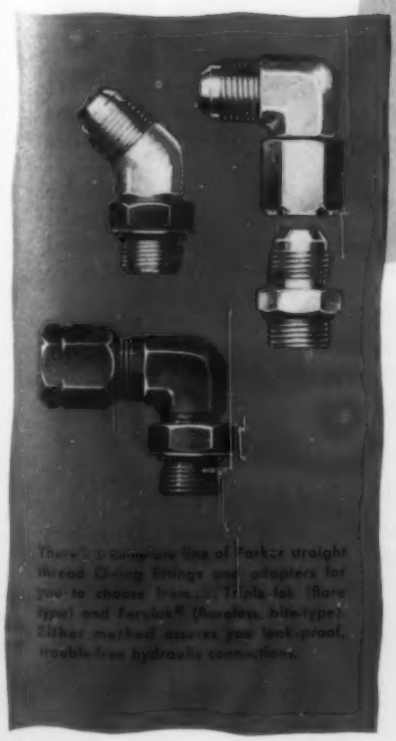


Specify straight thread O-ring boss on your Hannifin high-pressure hydraulic cylinders for leak-proof connections at no extra charge. These port connections, together with Hannifin piston rod seals, provide the answer to all your cylinder sealing problems.

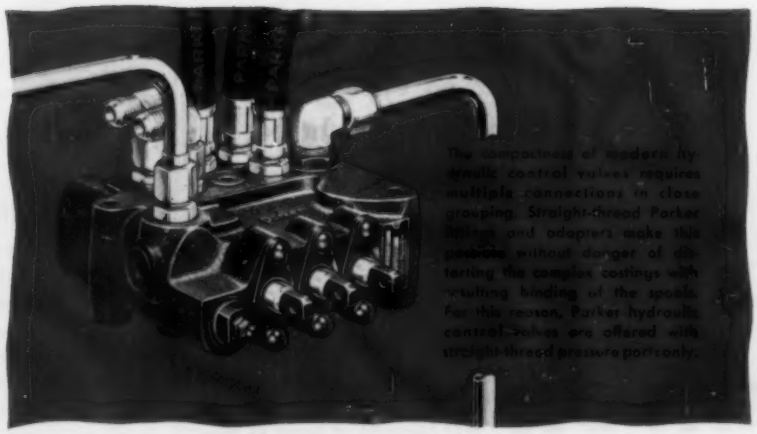


Both Parker's new "Krimp-lok" permanent-end hose assemblies and "Hose-lok" reusable fittings as well as all adapters) are available with straight threads, O-ring sealed for any specified fluid.

The O-rings used in Parker port connections are made only from service-tested Parker Seal Company compounds. With an ever-increasing number of fire-resistant fluids now on the market, it pays to avoid "jack-of-all-fluids" seals and stay with the Parker Seal compound specifically made for the fluid you will be using.



There's a complete line of Parker straight thread O-ring fittings and adapters for you to choose from... Triple-lok (flare type) and Ferulok® (flareless, bite-type). Either method assures you leak-proof, trouble-free hydraulic connections.



The compactness of modern hydraulic control valves requires multiple connections in close grouping. Straight-thread Parker fittings and adapters make this possible without danger of distorting the complex castings with resulting binding of the spools. For this reason, Parker hydraulic control valves are offered with straight-thread pressure ports only.

CONTROL VALVES?

Use Our Precision Production Facilities for Fabrication to Your Specifications

Our facilities are ideal for economical volume manufacturing of precision assemblies like the control valve pictured above, now in production in our plant for a large tractor manufacturer.

We will welcome an opportunity to work with you on prototype or production requirements. Let us quote on your needs.

EATON

SAGINAW DIVISION
MANUFACTURING COMPANY.
9771 French Rd. • Detroit 13, Mich.

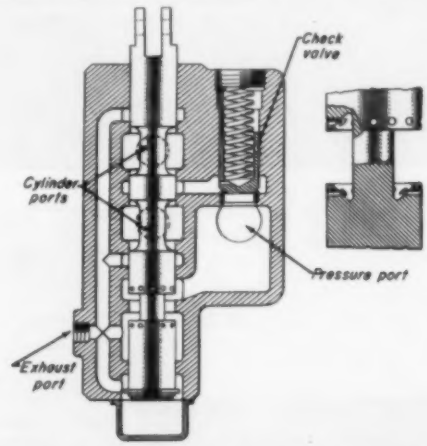
FLUID POWER PATENTS

BALANCED SPOOL CONTROL VALVE

Spool is designed to reduce unbalanced axial forces in an open-center control valve. These forces are caused by high fluid velocity as the ports open and close.

Valve is shown in its neutral position. Pump discharge enters the pressure port, flows around the recess in the spool, and out the exhaust port. Part of the oil also flows through the small holes near the edge of the spool land.

When the spool is raised and its lower land approaches the lower valve land, more oil is forced



through the holes. This decreases the quantity and velocity of oil flowing through the gap between the valve and spool lands. This is the velocity which causes unbalanced forces on the plunger.

Once the edge of the spool land enters the valve land, all flow is through the holes. Since this flow is not in line with the axis of the valve, no unbalanced forces are created. The spool continues to move up until all holes are covered by the valve land.

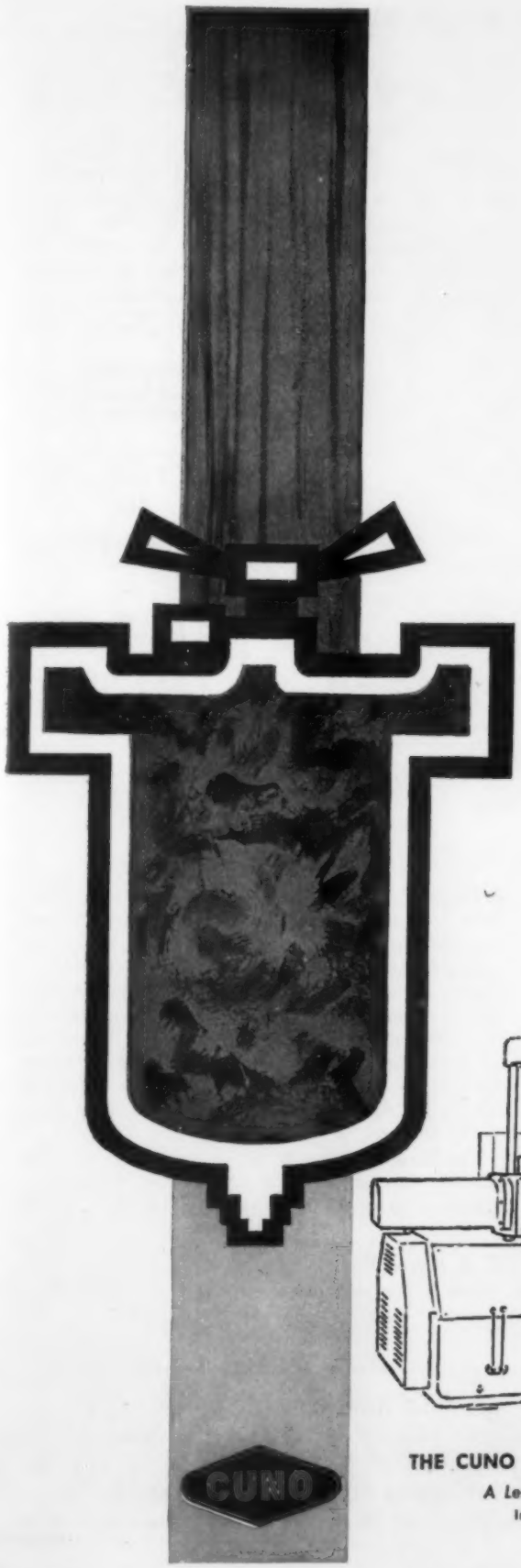
Another set of holes in the spool land above the valve land reduce axial forces in the same way when the spool moves down.

U. S. Patent 2,812,775, Robert F. Hodgson, assigned to The New York Air Brake Co., Kalamazoo, Mich.

2-PUMP UNLOADING CIRCUIT

In a conventional 2-pump hi-lo circuit, the output from the high-volume pump unloads back to the reservoir when the circuit pressure reaches a set value. The low-volume pump continues to deliver fluid at a pressure set by the system relief valve. In many circuits the relief valve setting is very close to the pressure setting of the unloading valve. A slight error

Continued on page 76



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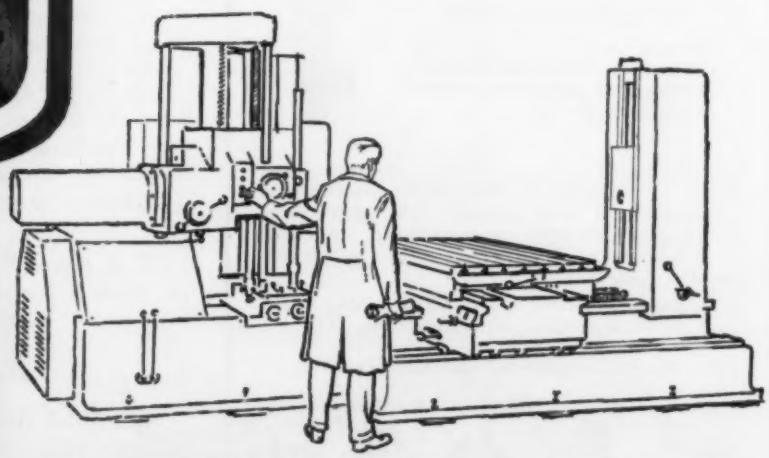

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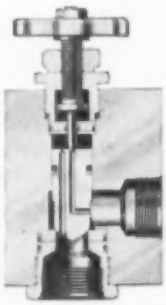

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in setting could cause the flow from the high-volume pump to pass through the relief valve and never reach the unloading valve setting.

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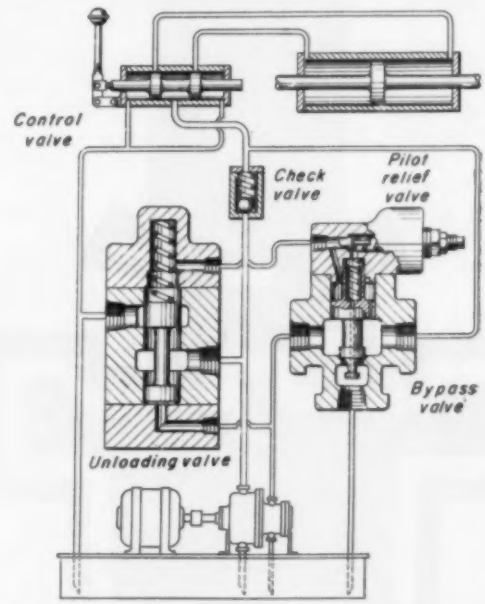

• **Operation**—Pressure from the low-volume pump aided by a spring keeps the unloading valve closed. This pressure comes through ports in the piston and body of the bypass valve. When system pressure reaches the value set by the spring on the pilot relief valve it opens slightly. This relieves the pressure from above the spools in the bypass and unloading valve. Oil from these chambers drains to the tank through the hole in the bypass valve spool. The unloading valve spool shifts and unloads the high-volume pump to the reservoir.

The bypass valve can be set to relieve the low-volume pump at the same pressure, or by using a slightly heavier spring it will relieve at a higher pressure.

U. S. Patent No. 2,728,194 by Everett O. Clark and Milton R. Fox, assigned to Vickers Inc., Detroit, Mich.

Other Patents Issued

VARIABLE DISPLACEMENT PUMP

No. 2,867,976 by Matthew W. Huber, assigned to The New York Air Brake Co.

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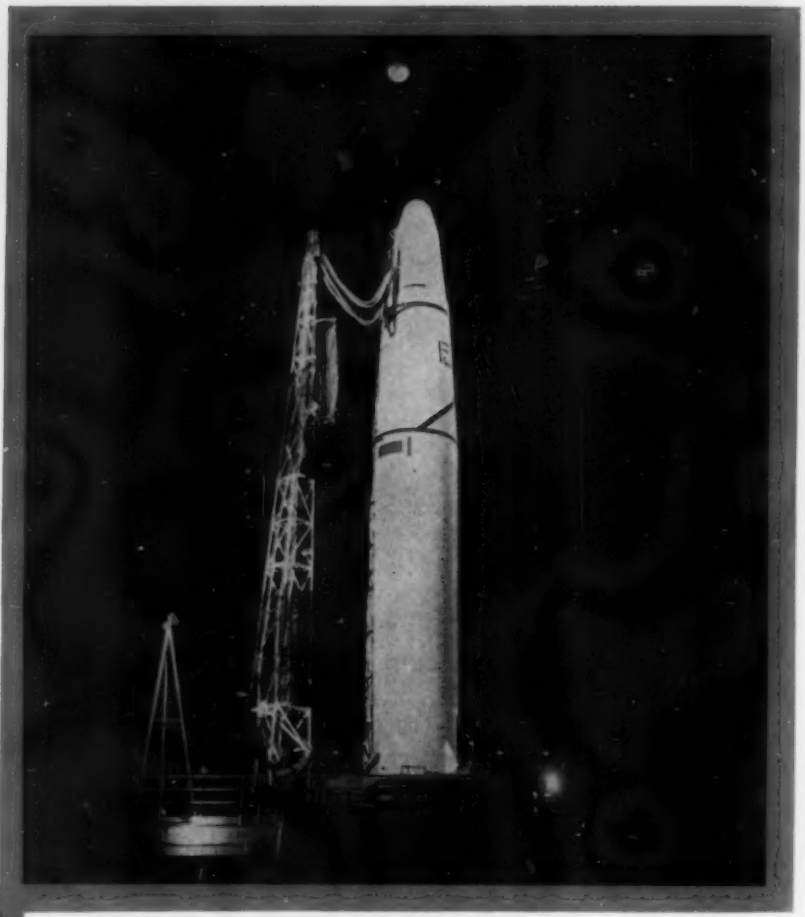

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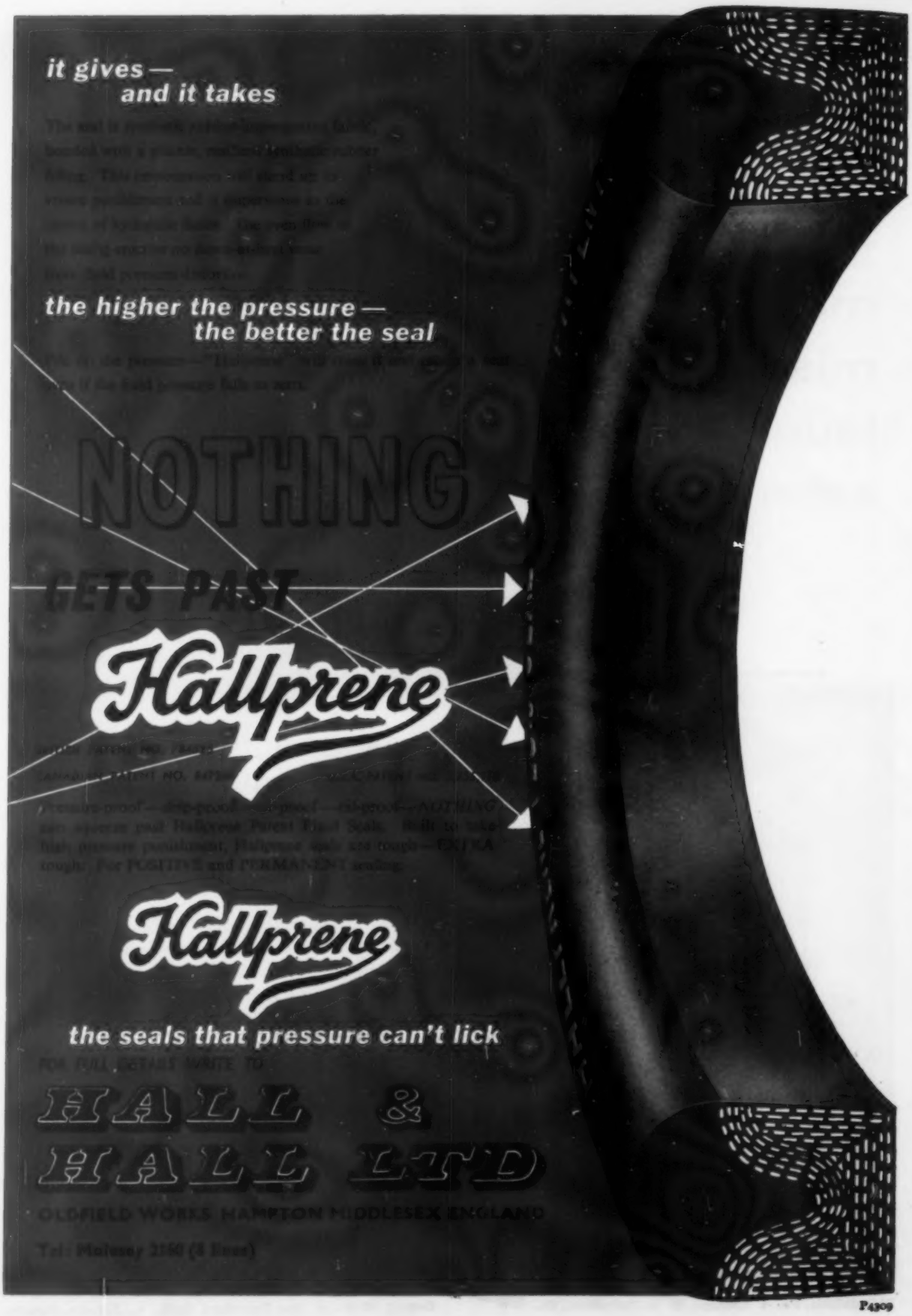
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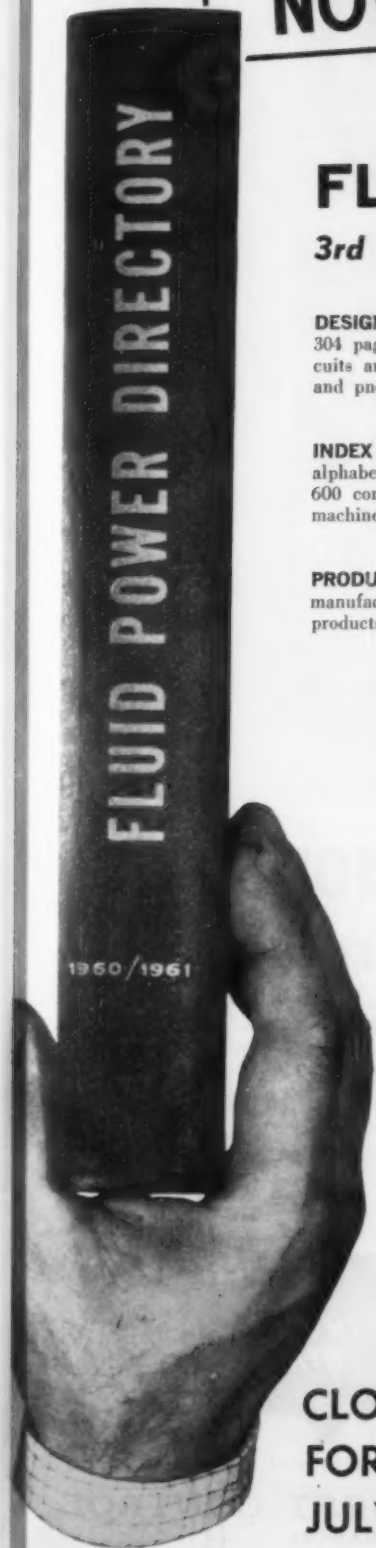

DESIGN DATA AND IDEAS—Section A gives you 304 pages of standards, nomographs, formulae, circuits and product designs. Complete JIC hydraulic and pneumatic standards.

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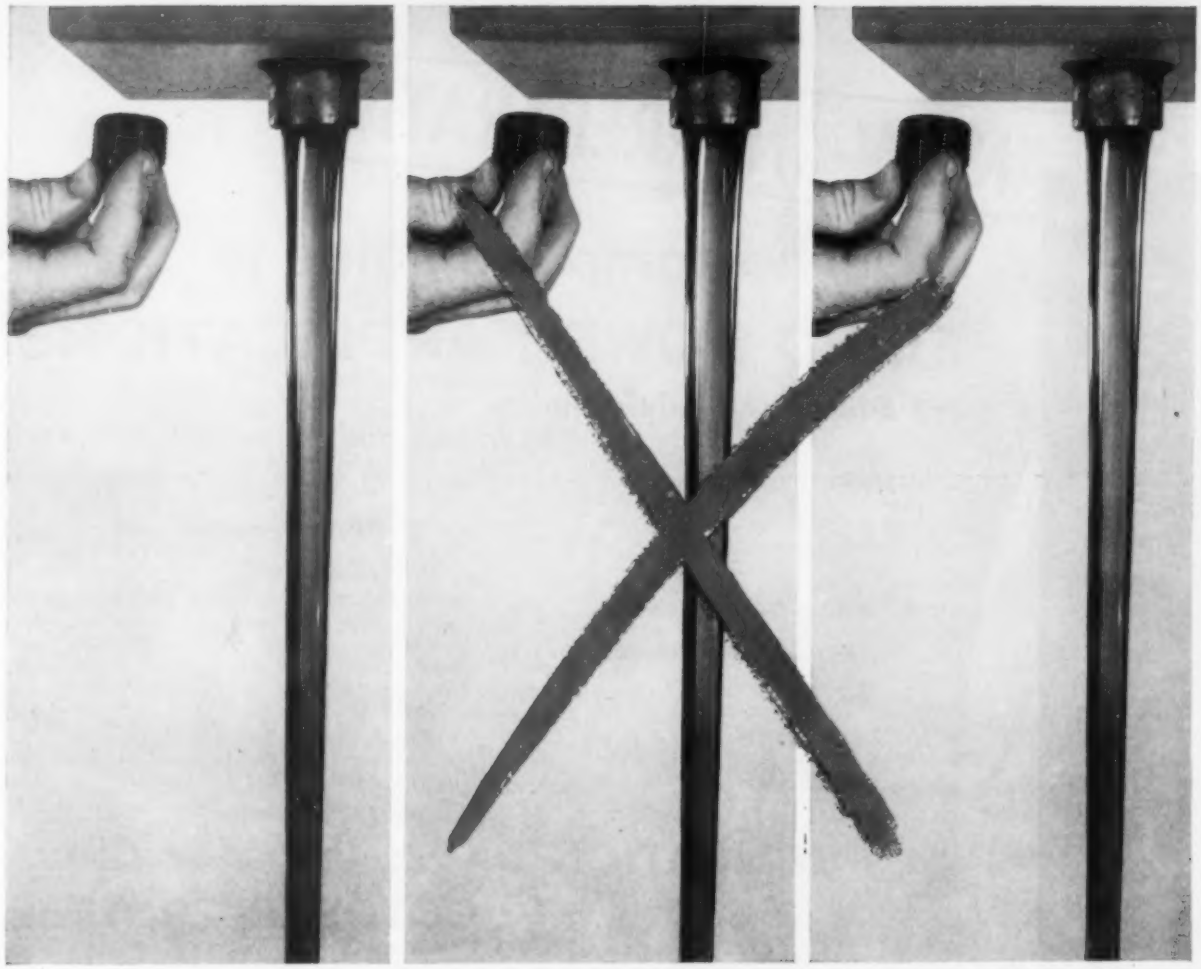

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Hydraulic Standards

for INDUSTRIAL EQUIPMENT

Revised and adopted at the April 15-17, 1959
JOINT INDUSTRY CONFERENCE
Rackham Building, Detroit, Michigan

The term *Industrial Equipment* referred to in these Joint Industry Conference (JIC) Hydraulic Standards is any equipment hydraulically actuated or controlled, used in or necessary for manufacturing processes and equipment assembly.

Mandatory requirements of this Standard are distinguished by the use of the word *shall*. Preferred items are distinguished by the use of the word *should*.

Specifications noted with an asterisk(*) were written as a guide in indicating the type of engineering that is considered to be desirable in new developments and in the re-engineering of equipment.

The prefix letter H is used throughout these JIC Hydraulic Standards to denote specific application to hydraulic equipment.

Proposals for changes in these JIC Hydraulic Standards are considered in Joint Industry Conferences held at intervals for this purpose. No additions, revisions or deletions shall be made if reproduced as JIC Standards.

Credit for the formulation of these JIC Hydraulic Standards is due the Joint Industry Conference which includes representatives of the following:

American Society of Lubrication Engineers (ASLE)
Die Casting Machine Builders
Formed Steel Institute
Hydraulic Equipment Manufacturers
Hydraulic Press Engineering Standards Committee (NMTBA)
Hydraulic Subcommittee (NMTBA)
Industrial Equipment Users
Industrial Heating Association (IHA)
Mechanical Packing Association (MPA)
National Fluid Power Association (NFPA)
National Industrial Leather Association (NILA)
National Machine Tool Builders Association (NMTBA)
Resistance Welder Manufacturers Association (RWMA)

Publication dates of these Standards are:
Released—September, 1948
Revised—September, 1949
Revised—January, 1953
Revised—April, 1959

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H0 GENERAL

H0.1 The purpose of these Standards is to provide detailed specifications for the application of hydraulic apparatus to industrial equipment which will promote:

a. Safety to personnel
b. Uninterrupted production
c. Long life of equipment
d. Ease and low cost of maintenance

These Standards are not intended to limit or inhibit advancement in the art of hydraulic or mechanical engineering.

H0.2 These Standards apply to all hydraulic equipment in industrial applications. Any exceptions to these Standards shall be as agreed to in writing between supplier and purchaser. Exceptions shall appear on purchase order and shall pertain to specific paragraphs of these Standards. Exceptions shall apply only to the order in question and shall not pertain to future orders.

H0.3 The purchaser shall specify on his inquiry and on purchase order such additional details as are required to meet unusual operating conditions.

H0.4 **A.** The industrial equipment builder shall submit for purchaser's approval preliminary performance data on hydraulic equipment in accordance with Section H1.

Final diagrams and text shall conform to the hydraulic equipment shipped. If field changes are made by the vendor, the changes shall be recorded by the vendor and a reproducible copy of the final changed drawing shall be forwarded to the purchaser.

B. Replacement part data, including seal numbers and other maintenance information shall be furnished for all hydraulic equipment. Seal numbers shall be in accordance with JIC Sealing Devices, where practicable. (See Appendix C.)

C. Preliminary approval shall be obtained by the vendor before hydraulic components are installed on equipment. After preliminary approval by purchaser, any deviations by equipment builder shall have purchaser's approval in writing.

H0.5 All hydraulic components shall be compatible with the fluids used and shall be installed and used in accordance with the recommendations of the component manufacturers.

H0.6 Hydraulic and lubricating systems shall be separated. Fluid from the hydraulic system shall not be used to lubricate ways, slides, exposed surfaces, or mechanisms not integral with hydraulic components. When separation is impracticable, the combination system shall be agreed to by the purchaser and all of the following conditions shall apply:

A. Unit pressure is low and operation is infrequent or of an auxiliary nature.

B. Means are provided to remove contamination.

C. Complete hydraulic and lubrication system information is given on the hydraulic diagram.

D. Both systems shall be capable of performing their intended functions with a fluid normally used by the purchaser.

H0.7 **A.** Under conditions of continuous operation, the pump inlet temperature of the fluid shall not exceed 130 F. at an ambient temperature of 80 F. If ambient temperature is above 80 F., it shall be specified on inquiry. See Paragraph H0.3.

B. When temperature control lower than 130 F. is required, the temperature shall be specified on inquiry and/or quotation and on purchase order.

C. Where water base fire-resistant fluids will be used, it shall be specified on inquiry and/or quotation and purchase order and the temperature of the fluid shall be controlled so as not to exceed 120 F.

H0.8 **A.** All industrial equipment, at the completion of assembly and before shipment, shall be given complete performance tests to determine conformity with equipment specifications.

B. There shall be no external leakage from hydraulic components and piping.

C. Hydraulic reservoir shall be thoroughly cleaned prior to shipment.

D. All openings in hydraulic equipment shall be sealed prior to shipment.

H0.9 A pressure-time diagram showing, under actual operating conditions, data concerning maximum rate of pressure rise, maximum surge pressure and surge frequency, shall be furnished when specified on inquiry and on purchase order.

H0.10 Hydraulic equipment and piping shall be accessible and shall be mounted in a position that it will not interfere with the equipment adjustments or maintenance.

H1 DIAGRAMS

H1.1 **Types and Definitions.** Four types of diagrams are covered by this Standard. A Graphical Diagram may be used for quotation, piping the installation, and for analyzing circuit operation. A Cutaway Diagram is often used for instruction purposes. A Pictorial Diagram may be used for quotation and piping the installation. A Combination Diagram is used to emphasize the purpose and operation of a portion of the system.

H1.1.1 **Graphical Diagram**—A drawing or drawings showing each piece of hydraulic apparatus, including all interconnecting lines by means of approved (ASA, JIC) standard symbols. Diagrams of this type provide a simplified method of showing function and control of each component.

A. Graphical diagrams shall be furnished with industrial equipment. A cutaway diagram is acceptable if specifically requested by purchaser. (See Appendix G for example of a Graphical Diagram.)

B. Two copies of the diagram shall be inserted in a permanent data pocket attached to the inside cover of the hydraulic control enclosure or a suitably covered hydraulic diagram enclosure.

H1.1.2 **Cutaway Diagram**—A drawing showing:

1. Principal internal working parts of all hydraulic components.
2. Controls and actuating mechanisms.
3. All interconnecting lines.
4. Function of individual components.

A. When requested on inquiry and on purchase order, a cutaway diagram shall be supplied.

B. When requested on inquiry and on purchase order, a cutaway diagram shall show and describe the flow paths for each phase of each complete cycle. (See Appendix G for example of Cutaway Diagram.)

C. When requested on inquiry and on purchase order, a cutaway diagram shall show, in color or pattern code, only those portions of the circuit which are functioning at each single phase of the cycle. (See H1.4.)

H1.1.3 Pictorial Diagram—A drawing showing:

1. Each component in its actual shape according to the manufacturer's installation drawing.
2. All interconnecting lines.
3. General piping arrangement.

When requested on inquiry and on purchase order, a pictorial diagram shall be furnished. (See Appendix G for example of Pictorial Diagram.)

H1.1.4 Combination Diagram—A drawing utilizing a combination of graphical, cutaway and pictorial symbols showing interconnecting lines.

When requested on inquiry and on purchase order, a combination diagram shall be furnished. (See Appendix G for example of Combination Diagram.)

H1.2 All Diagrams.

A. The descriptive text shall explain the function of the operations. Either the diagram or descriptive text shall include, in addition to the sequence of operations, the following:

1. Identification of all hydraulic equipment by name, catalog number, serial or design number, and manufacturer's name.
2. Size of line (outside diameter and wall thickness).
3. Diameters of pistons and rods, length of stroke, and estimated required force of cylinders when other than maximum pressure is applied.
4. Time of cycle, e.g., time range of cycle exclusive of loading.
5. Operating pressures and maximum pump-rated pressure.
6. Horsepower, rpm, and direction of rotation of each pump drive.
7. Pump speed and delivery in gpm.
8. Reservoir capacity.
9. Recommended fluid type and viscosity range.
10. Displacement, speed range, and torque rating of each hydraulic motor.
11. Data or text, or both, shall show operations performed with related electrical and mechanical control and actuating equipment.
12. Quantity, capacity and type of strainer and filter.

B. The related text and the diagram shall be shown on the same or facing pages.

C. A reproducible copy of all approved diagrams and texts shall be forwarded to the purchaser not later than the date on which the shipment is made. The reproducible copy shall permit changes to be made and shall not be folded. These reproducible copies shall be marked with the equipment serial number and purchaser's order number.

D. The drafting practice and format of all diagrams shall be in accordance with Section 17, Fluid Power Diagrams, of American Drafting Standards manual, ASA Y14.17. (See Appendix K.)

E. See Appendix F for examples of Complete Circuit Diagrams.

H1.3 Standard Graphical Symbols. (See Appendix A.)

Introduction:

Graphical symbols shall be in accordance with American Standard Graphical Symbols for Fluid Power Diagrams, ASA Y32.10. (See Appendix K.)

H1.3.1 Symbol Rules (from ASA Y32.10).

A. Symbols show connections, flow paths and function of component represented. They do not indicate conditions occurring during transition from one flow path arrangement to another. Further, they do not indicate construction, or values such as pressure, flow rate, and other component settings.

B. Symbols do not indicate location of ports, direction of shifting of spools, or position of control elements on actual component.

C. Symbols may be rotated or reversed without altering their meaning except in the case of

a. lines to reservoir
b. vented manifold

D. Line width does not alter meaning of symbols.

E. Symbols may be drawn any suitable size. Size may be varied for emphasis or clarity.

F. Letter combinations used as parts of graphical symbols are not necessarily abbreviations.

G. Where flow lines cross, a loop shall be used except within a symbol envelope. Loop may be used in this case if clarity is improved.

H. In multiple envelope symbols, flow condition shown nearest a control symbol takes place when that control is caused or permitted to actuate.

I. Each symbol is drawn to show normal or neutral condition of component unless multiple circuit diagrams are furnished showing various phases of circuit operation.

J. Arrows shall be used within symbol envelopes to show direction of flow path in component as used in the application represented. Double-end arrow shall be used to indicate reversing flow.

K. External ports are where flow lines connect to basic symbol, except where component enclosure is used. External ports are at intersections of flow lines and component enclosure symbol when enclosure is used.

H1.4 Fluid Legend Code

H1.4.1 Color Code

Function	Color
Intensified Pressure	Black
Supply	Red
Charging Pressure Reduced Pressure Pilot Pressure	Intermittent Red
Metered Flow	Yellow
Exhaust	Blue

Intake, Drain ..... Green

Inactive ..... Blank

H1.4.2 Pattern Code

Function		Zip-a-Tone Pattern & No.
Intensified Pressure	#7R	
Supply Pressure	#177	
Charging Pressure, Pilot Pressure, Reduced Pressure	#52	
Metered Flow	#63	
Exhaust	#75	
Intake, Drain	#16	
Inactive	Blank	

H1.4.3 Definition of Functions

Function	Definition
Intensified Pressure	Pressure in excess of supply pressure which is induced by a booster or intensifier.
Supply Pressure	Power-actuating fluid.
Charging Pressure	Pump-inlet pressure that is higher than atmospheric pressure.
Reduced Pressure	Auxiliary pressure which is lower than supply pressure.
Pilot Pressure	Control-actuating pressure.
Metered Flow	Fluid at controlled flow rate, other than pump delivery.
Exhaust	Return of power and control fluid to reservoir.
Intake	Sub-atmospheric pressure, usually on intake side of pump.
Drain	Return of leakage fluid to reservoir.
Inactive	Fluid which is within the circuit, but which does not serve a functional purpose during the phase being represented.

H1.5 Diagram Size

H1.5.1 **A.** The diagrams, sequence of operations, and descriptive text, when practicable, should be shown on the same sheet.

If more than one sheet are required, they shall be cross-referenced. All sheets shall be either 8½" x 11" or 9" x 12" or whole multiples thereof. Diagrams shall be of such size that all information is clearly legible. Maximum size of sheet shall be 36" x 48".

B. More than one sheet shall not be acceptable unless all the diagrams and information required cannot be shown on a single sheet of maximum size.

H2 HYDRAULIC CONTROLS

H2.1 **Definition of Controls.** **A.** Manual controls are those actuated by the operator.

B. Automatic controls are those actuated in response to the cycle of the equipment.

H2.3 Protection

H2.3.1 **A.** Over-pressure protection shall be provided on the discharge side of all pumps.

B. The adjustments on the pressure-control units shall be accessible.

C. When specified by purchaser on inquiry and on purchase order, provisions shall be made to permit locking with key-type lock, the individual component settings or the enclosure or compartment in which volume or pressure control units are mounted.

H2.3.2 All pressure and volume controls shall be constructed so that they are not adjustable outside their nominal safe working ranges. All pressure controls shall be marked to indicate minimum and maximum pressures.

H2.3.3 **A.** Where there is more than one pump on the equipment, interlocks shall be provided so that the stoppage of one pump in the circuit will not damage the equipment.

B. Where the operation of one pump in improper sequence can result in damage, interlocks shall be provided to ensure the operation of all pumps in proper sequence.

H2.3.4 Where there are pumps in parallel, valving which will permit removal of one pump while the others are still in operation shall be provided when requested on inquiry and on purchase order.

H2.3.5 Where pumps are to operate in series, pressure protection shall be provided to prevent any one pump from carrying the entire load. (This will not apply to centrifugal pumps in series.)

H2.3.6 Where loss of working pressure on the discharge side of a pump or pumps may result in damage to the equipment, in loss of accuracy or danger of injury to personnel, means shall be provided to prevent operation under these conditions.

H2.3.7 Where there is more than one hydraulically or manually controlled device on any industrial equipment, and where possible damage may be caused by the failure of any one device to function properly, the circuits shall be arranged with protective interlocks. When practicable, these interlocks shall interrupt all operations, provided such interruptions shall not constitute a hazard to personnel or cause damage to the equipment or work in process.

H2.4 Circuit Controls

H2.4.1 When shifting from rapid traverse to feed, the starting position of the feed rate shall be maintained consistent with the type of service intended.

H2.4.2 Hydraulic circuits shall be designed to minimize generation of heat.

H2.4.3 Electrically controlled hydraulic devices shall be applied in such a manner that in the event of electrical circuit failure, there will be no damage to the equipment or danger of injury to personnel.

H2.4.4 Neutral valve positioning controls shall be independent and unaffected by adjustment of other controls.

H2.4.5 When requested, quoted and ordered, feed and cycle-limiting trip devices shall be arranged so that the feed distance can be set and sealed. After feed distance is preset, the control mechanism shall be adjustable as a unit.

H2.4.6 **A.** Positive-position stops shall be designed so that the dwell time will not be affected when positive-position stops are reset.

B. Positive-safety stops for machine slides shall not be adjustable, but shall have provision for replacement.

H2.4.7 Hydraulic components attached to the industrial equipment shall be located so that they can be serviced with safety.

H2.4.8 Hydraulic circuits shall be designed, constructed and the components adjusted to minimize surge pressures. The components shall be of a strength which will withstand such surge pressures.

H2.4.9 Means shall be provided to prevent uncontrolled movement of hydraulic actuators in all portions of the equipment cycle, including pump starting and idling.

H2.4.10 Hydraulic feed circuits shall be designed and components adjusted to maintain consistent feed rates independent of reverse force or intermittent loads.

H2.4.11 Circuits having two or more heads, slides, or actuators shall be designed to ensure that all units operate in proper relationship regardless of load variations.

H2.4.12 Hydraulic circuits for mass production equipment shall be so designed and applied that load variations and changes in fluid temperature shall not cause variations in the cycle time inconsistent with service intended, provided voltage, frequency, and manual operations do not change.

H2.4.13 Sequence control by pressure switches or direct operated pressure control valves shall not be used alone to determine sequence of operations, except where the function of the operation requires the use of such devices. Sequence shall be primarily governed by mechanically actuated limit switches, hydraulic valves or other position sensing devices.

H2.5 Enclosures and Compartments

H2.5.1 For the purpose of these standards, an enclosure means a housing for hydraulic apparatus. A compartment means a space within the base, frame, or column of the equipment.

H2.5.2 Automatic controls, which might be damaged by exposure to dirt or dust or stock-moving equipment, shall be adequately protected and readily accessible.

H2.5.3 **A.** Doors and other parts of compartments for automatic controls shall be sheet steel not less than 14 USS Gauge, or cast metal not less than ¼" thick.

B. All enclosures shall have hinged covers, which swing horizontally, or self-supporting sliding covers. Doors shall be held closed with mechanical fasteners of the captive type.

H2.5.4 Compartments for automatic controls shall be completely isolated from coolant, cutting or lubricating oil, chips and dirt.

H2.5.5 All automatic-control devices shall be mounted in one enclosure where possible and advisable.

H2.5.6 The arrangement of enclosures for mounting controls shall provide adequate room for maintenance.

H2.5.7 Solenoid operated valves shall incorporate the following features:

a. Suitably sealed solenoid enclosure to prevent the entrance of splashing liquids and air-borne contamination.
b. Sufficient internal space to incorporate six-inch leads and taped joints.
c. Ring type pressure connectors on leads.
d. Threaded electrical conduit connections.
e. Captive type fasteners for retaining cover.
f. Suitable means, usually a light link chain, to prevent loss of cover from enclosure.
g. Manual over-rides which can be operated without removing the solenoid covers but cannot be operated accidentally.
h. Suitable means to prevent electrical operation when solenoid enclosure or cover are removed.

H2.6 Mounting

H2.6.1 **A.** (1) Hydraulic equipment and piping shall be so located or protected as to prevent damage from material handling equipment.

(2) All controls shall be protected against falling objects and operator's accidental movements.

(3) Hydraulic equipment and piping shall not be subjected to excessive temperature or located where subjected to other detrimental effects.

B. Manual Controls: All manual controls shall be mounted within reach of the operator when in his normal operating position. Operator shall not be required to reach past revolving spindles or moving tools to reach manual controls. (See Paragraph H7.1.2.)

C. Automatic Controls: Automatic controls shall be located and protected to prevent accidental operation.

H2.6.2 All hydraulic controls shall be mounted so that they are accessible for adjustment and maintenance. Unless the size of the equipment or function require other mountings, the controls shall be mounted a minimum of two feet or a maximum of six feet above working floor level of the equipment.

H2.6.3 Hydraulic control units shall be mounted in positions which provide complete accessibility to all units for maintenance without interfering with adjacent equipment.

H2.6.4 All valves and other controls shall be mounted on panel or adjacent to the related power unit, unless size or function require other mountings.

H2.6.5 All industrial equipment shall incorporate an emergency stop or return control which shall be readily accessible from operator(s) normal working position.

H2.6.6 Piping should not be used to support valves or equipment.

H3 PUMPS

H3.2 Data Sheet

H3.2.1 A data sheet or catalog, listing information on rpm, pressure range, delivery, horsepower required, and viscosity range, shall be provided.

H3.3 Mounting Pumps

H3.3.1 **A.** Pumps, or subassemblies including the pumps, shall be readily accessible for maintenance.

B. Pumps shall not be mounted inside reservoir.

H3.3.2 Pumps shall be mounted where they are adequately protected from damage.

H3.3.3 **A.** Direct-coupled pumps shall be securely mounted in a manner to assure alignment under normal operating conditions.

B. The coupling shall have adequate capacity to transmit the power required.

C. The mounting surface provided for the pump and motor shall be rigid and prevent coupling misalignment due to work load and temperature variations.

D. Flexible couplings shall be used between the motor and pump, and be of a type approved by the purchaser.

E. A detachable safety guard shall be fastened over the coupling.

H3.5 Pump Nameplates

H3.5.1 The following information shall be permanently indicated on each hydraulic pump:

a. Manufacturer's name and address.

b. Manufacturer's part, model and/or serial numbers.

H3.5.2 Whenever a pump nameplate is not readily visible, a nameplate with duplicate information shall be provided adjacent to the pump where it can be easily read.

The original nameplate shall not be removed from the pump.

H3.5.3 The direction of rotation of each pump shall be clearly indicated on the pump where it can be readily seen.

H4 PIPINGS, FITTINGS AND FLUID PASSAGES

(Piping includes all pipe, tubing, hose, and fittings. Passages include all fluid conductors other than piping.)

H4.1.1 When requested on inquiry and on purchase order, a piping layout or photograph shall be furnished.

H4.1.2 **A.** Cross-sectional area of the piping shall be sufficient to prevent cavitation or starvation and undue temperature rise or turbulence.

B. Piping shall have adequate strength to withstand additional pressure, including surge pressure, within the safety limits of the entire circuit.

C. A factor of safety of 8:1 shall be provided in the pressure range of 0 to 1,000 psi. (See Appendix A.)

D. Intake suction shall not exceed five inches of mercury.

E. Fluid velocity through piping on production equipment shall normally be limited to 15 feet per second. When higher velocities are required, the hydraulic equipment involved shall be compatible.

H4.1.3 **A.** Surges shall be minimized at their sources. Adequate protective devices shall be provided in piping circuits to protect piping and fittings against hydraulic impact.

B. The strength of the piping shall be adequate to withstand the maximum rate of surge pressure rise and the maximum surge peak pressure at the frequency developed by the cycling of the equipment operation.

H4.1.4 Piping between actuating devices and feed control devices shall be short and rigidly mounted to eliminate vibration and chattering and to maintain a constant rate of flow of fluid through the piping.

H4.1.5 **A.** Solderless pipe connections shall be used, e.g., flared, flareless, self-flaring, flanged, or equivalent.

B. The performance of any type fitting used shall equal or exceed the requirements of MIL-F-5506. (See Appendix K.)

C. When flared-type fittings are used, which require a flaring tool, the angle of flare and other flare dimensions shall be in accord with Military Service (MS) 33584. (See Appendix K.)

D. When flared-type fittings are used, the construction of the tube end, i.e., the tubing end of the connector body, nut and sleeve when used, shall be 37° from center, 74° included angle, and shall conform to MIL-F-5509 for minimum performance requirements. (See Appendix K.) Modifications may be made if performance conforms to the requirements of H4.1.5 (B).

E. Fittings that incorporate separate synthetic or metal to metal seals or seals that seal with pressure should be equipped with Unified National Fine (UNF) straight thread port connections. Fittings that incorporate synthetic or metal to metal seals or seals that seal with pressure may by used with pipe thread port connections.

F. All pipe threads shall be Dryseal American (National) standard taper pipe threads (NPTF).

G. All piping connections shall be so designed and installed as to permit quick removal and reassembly by means of hand tools.

Piping, Tubing and Fittings (See Appendix B).

1. The recommended standard sizes of hydraulic tubing for pilot and power transmission lines are: ¼", 5/16", ⅜", ½", ⅝", ¾", ⅞", 1" 1¼" and 1½". For special lines, such as air bleedoffs or restrictive flow paths, other sizes are permissible by agreement with purchaser.
2. Tubing shall conform to the specifications set forth in Appendix D and E, Seamless and Welded Steel Tubing. Pipe shall conform to the requirements of ASTM Specifications A106 Grade B. Such pipe shall

also conform to the cleanliness requirements of Appendix D.

3. Steel fittings shall be used.
4. Fittings with restricted or stepped-up passages are not recommended.

H4.1.6 All piping, piping fittings, oil passages, cored holes or drilled holes shall be free of burrs or foreign matter which might cause damage to any hydraulic unit or contamination of the hydraulic fluid.

H4.1.7 **A.** Each piping run shall be integral and continuous from one piece of apparatus to another. Couplings shall be used only where necessary for length and assembly. Piping runs shall be removable without dismantling equipment components.

B. All piping shall be securely supported to avoid vibration or movement. Tubing lengths between supports shall be as specified in Table 1. Points of contact or support on the outside of the piping shall be designed so that they will not damage it. Piping shall not be welded to supports.

TABLE 1

Tube (Outside Diameter) (In inches)	Approximate Tubing Lengths Between Supports (In feet)
¼, 5/16, ⅜, ½	3
⅝, ¾, ⅞	4
1	5
1¼, 1½	7

H4.1.8 Flange connections shall use sealing devices that seal with pressure. All welded joints for service above 2,500 psi shall be stress relieved.

H4.1.9 **A.** Flexible hose used in circuits over 150 psi operating pressure should have a safety factor of at least five. Below 150 psi, flexible plastic tubing may be used.

B. Flexible hose and flexible plastic tubing ends shall have vertical terminations and shall have sufficient slack to avoid sharp flexing and straining. Horizontal connections are acceptable only if flexible lines are adequately supported.

H4.1.10 Piping shall not be placed in a location on the machine where it will interfere with the adjustment, repair or replacement of controls or units. Piping connections shall be readily accessible for maintenance.

H4.1.11 Hydraulic units provided with external drain connections shall be drained independently to reservoir or to a vented manifold.

H4.2 Identification of Piping

H4.2.1 When equipment is constructed to require shipping or moving in sections, thorough precautions shall be taken to protect and identify piping runs to correspond with diagram. All male threads shall be sleeved, and all piping openings or female threads shall be equipped with suitable closures.

H4.2.2 Piping shall be arranged so that pressures may be tested at accessible locations. Built-in checking stations shall be provided and shall be indicated on the diagrams.

H5 FLUID RESERVOIRS

H5.1 **A.** The reservoir shall be designed and constructed to prevent entry of foreign matter, including water.

B. Reservoirs should be separate and removable from the equipment base.

C. Cast reservoirs shall be impregnated and sealed before assembly into equipment, with a sealer which is inert to petroleum base fluids or fire resistant fluids, whichever is applicable.

H5.1.1 **A.** The filler holes shall have a strainer for straining the fluid when filling, fixed with fasteners requiring hand tools for removal.

B. Filler holes shall be provided with well-fitted caps or covers permanently attached to the reservoir by some suitable means.

H5.1.2 **A.** All reservoirs shall have at least two openings to eliminate pressure buildup while filling.

B. A breather hole shall be provided and shall be protected by an air cleaner.

C. The air cleaner shall be of sufficient capacity to maintain approximate atmospheric pressure at maximum demands of the hydraulic system and shall prevent entrance of splashed liquids.

D. Combination breather and filler assemblies are preferred.

H5.1.3 **A.** Reservoirs shall be designed for adequate heat dissipation.

B. Return fluid shall have peripheral flow along reservoir sidewall.

H5.1.4 Where reservoirs are not mounted on equipment, the bottom of the reservoir shall have a minimum clearance of six inches from the floor. The legs shall have appropriate mounting holes for lag screws.

H5.1.5 The capacity of the fluid reservoir shall be sufficient to:

a. Contain all of the fluid that will drain from the system back into the reservoir by gravity flow.

b. Maintain the fluid level within an adequate working height during operating cycle.

H5.1.6 The reservoir shall be equipped with a flush mounted or protected fluid level indicator, preferably located near the filler cover. It shall be provided with markings to show high and low levels with pump running and, where necessary, high level with pump stopped.

H5.1.7 Both the intake and return pipe shall be brought down below the minimum working fluid level so as not to cause cavitation or aeration.

H5.1.8 Suitable means, such as baffles, shall be provided between the intake and return lines to facilitate the separation of air and foreign matter from the hydraulic fluid.

H5.1.9 Ample and accessible provisions shall be made for complete cleaning of the reservoir.

H5.1.10 A well-protected and accessible means shall be provided to empty the reservoir without spillage. The reservoir bottom shall be shaped to facilitate emptying and cleaning.

H6 VALVES, ACCESSORIES AND DEVICES

H6.1 Filters, Strainers and Magnets

H6.1.1 A filter shall be provided for the continuous removal of materials from the hydraulic fluid which are detrimental to the operation of the equipment.

H6.1.2 If a specific type and design of filter, strainer or magnet is required by the purchaser, it shall be specified on the inquiry and on purchase order.

H6.1.3 Self-Cleaning strainers shall be automatically actuated.

H6.1.4 **A.** Filters shall be so constructed and installed that the filter medium can be changed without disturbing the piping or stopping equipment operations.

B. On continuous processing equipment, means shall be provided to change filter medium without stopping equipment operation.

C. Suitable means shall be provided to indicate when filter should be serviced.

H6.1.5 **A.** When suction strainers are installed, they shall be of a size which will strain more than double the intake capacity of the pump.

B. Means shall be provided to remove or service strainers without draining the reservoir.

H6.1.6 Bypass filters shall be of sufficient capacity to filter the equivalent of all hydraulic fluid in the system within a period of eight hours.

***H6.1.7** **A.** Magnets shall be provided in the reservoir. They shall be of sufficient quantity and strength to pick up ferrous particles not retained by strainers and filters in the reservoir.

B. Magnets shall be assembled to support bars and shall be located between the return side of reservoir and suction strainers. Magnets shall be easily removable for servicing.

* ENGINEERING DEVELOPMENTS: Standard specifications noted with an asterisk (*) were written as a guide in indicating the type of engineering that is considered to be desirable in new developments and in the re-engineering of equipment.

H6.2 Sealing Devices

H6.2.1 All sealing devices shall be of suitable materials which will not be adversely affected by the hydraulic fluid.

H6.2.2 When practicable, sealing devices shall be of the pressure sealing type.

H6.2.3 Sealing devices on reciprocating or rotating shafts shall prevent all leakage, except that required for lubrication of such devices under all working conditions without damaging shafts.

H6.2.4 Clearances in sealing glands shall prevent any extrusion of the sealing material.

H6.2.5 Stuffing boxes for automatic packing shall be designed to prevent adjustment beyond the functional limits.

H6.2.6 Heads, slides and actuators shall be designed to facilitate easy replacement of continuous ring packings.

H6.3 Cylinders and Pistons

H6.3.1 Cylinder bores with fitted pistons shall have a degree and type of finish consistent with the type of service intended and shall be free of porosity or other defects.

H6.3.2 Cylinders shall be located in alignment with work slides and shall be installed so that no side or radial load shall occur on piston rod or ram.

H6.3.3 **A.** Ends of cylinders shall utilize sealing devices that do not leak under any working conditions.

B. Sealing devices that seal with pressure are recommended.

C. All cylinder external sealing devices shall be readily accessible for servicing.

H6.3.4 Cylinders shall be accessible for servicing, and shall be replaceable.

H6.3.5 Metallic rings used as sealing devices on pistons shall be of the step-cut type or sealing devices of equivalent performance. Where no leakage other than that required for lubrication can be tolerated, other sealing devices may be used.

H6.3.6 Piston rods shall be adequately protected by installation of cleaning and sealing devices. Material and hardness of piston rod shall be such as to minimize scoring. When quoted and ordered, dual piston rod seals with interseal drain back to tank shall be provided.

H6.3.7 When pistons are assembled to rods they shall be positively locked.

H6.3.8 Where necessary, cushions shall be provided on cylinder ends.

H6.3.9 Flow of fluid into non-rotating cylinders shall be at extreme tops of bores or other means provided to prevent entrapment of air.

H6.4 Valves

H6.4.1 Adjustable valves shall be arranged so that the adjustment can be locked or sealed.

H6.4.2 **A.** Valves shall not be mounted in reservoirs.

B. Valves shall be kept above high fluid level of reservoir except where the functions of the valves require them to be below the fluid level.

H6.4.3 **A.** Gasket mounted valves should be used whenever possible so that their removal and replacement can be made without breaking individual fluid lines.

B. Gaskets of the pressure sealing type shall be used.

C. Gasket mounted valves shall have locating pins.

H6.4.4 The operation of a valve shall not produce detrimental surges in the hydraulic system.

H6.4.5 On vertical or inclined slides or rams, means shall be provided to prevent rapid drop when hydraulic power is shut off.

H6.4.6 Solenoid operated valves shall be designed, constructed and installed to eliminate destructive hammering of the solenoid or spool. See Paragraph H2.5.7.

H6.4.7 Internal leakage shall be drained to reservoir or vented manifold to prevent blocking of plunger type controls.

H6.5 Accumulators

H6.5.1 The accumulator shall be constructed to withstand at least five times the operating pressure of the hydraulic system it serves.

H6.5.2 Means shall be provided for safely relieving accumulator gas and liquid pressure before accumulator can be disassembled.

H6.5.3 Hydraulic circuits incorporating accumulators shall be arranged so that the system can be bled at the high point of the circuit.

H6.5.4 See Paragraph H7.1.3 — Safety Section

H6.5.5 The following information shall be permanently indicated on each hydraulic accumulator:

a. Manufacturer's name and address
b. Manufacturer's model number
c. Manufacturer's serial number, if any
d. Rated maximum operating pressure
e. Charging medium
f. Fluid capacity

H6.6 Heat Exchangers

H6.6.1 The use and application of heat exchangers shall be subject to approval by the purchaser.

H6.6.2 It shall be the responsibility of the purchaser to advise supplier incorporating the heat exchanger in the equipment of any unusual temperature that would affect the equipment operation.

H6.6.3 The heat exchanger shall be readily accessible for removal in the event that servicing or repair is necessary.

H6.6.4 The heat exchanger shall be arranged so that it is protected against excessive pressures or pressure surges.

H6.6.5 The make, pipe size, capacity and rates of flow shall be clearly indicated on the hydraulic diagram and on the heat exchanger.

H6.6.6 Accessible arrangements shall be provided for checking inlet and outlet temperatures of the hydraulic fluid if circulating type heat exchangers are used.

H6.6.7 Heat exchangers shall be equipped with automatic thermal controls.

H6.7 Identification of Valves, Accessories and Devices

H6.7.1 All hydraulic valves, accessories and devices shall be plainly identified with the same identification as shown on the diagram. Such identification shall be shown on a tag, preferably metal, mounted adjacent to, not on, the component.

H6.7.2 All valve porting shall be identified adjacent to ports.

H6.7.3 All solenoids operating hydraulic equipment shall be identified. Each solenoid shall have the same identification on both the electrical and hydraulic diagrams.

H7 SAFETY

H7.1.1 Flexible lines shall be restrained or confined if their failure might constitute a hazard to personnel.

H7.1.2 Operator shall not be required to reach past revolving spindles, moving tools, or moving machine or equipment elements to reach manual controls.

H7.1.3 **A.** Hydraulic circuits incorporating accumulators shall be interlocked to vent or isolate accumulator fluid pressure when power is shut off.

B. On circuit applications, where accumulator pressure is isolated, full information shall be given on or near accumulator for proper servicing to prevent injury to personnel.

H7.1.4 Gas accumulators operating above 200 psi charging pressure shall be charged with nitrogen unless fire resistant fluids are used in which case air is permissible.

H7.1.5 Electrically controlled hydraulic devices shall be applied so that in the event of electrical failure, there will be no damage to the equipment or danger of injury to personnel.

H7.1.6 Nameplate shall be provided for all control station components and located so that they can be easily read by the equipment operator.

H7.1.7 Hydraulic power units at an elevated height shall be provided with safe means for access.

H7.1.8 **A.** The circuit shall require maintained depression of each control throughout the cycle or until a point is reached in the cycle where the hazard ceases.

B. The controls shall be so located and guarded that operation by means other than by both hands of the operator is prevented.

C. The circuit shall be so designed that the equipment cannot be operated unless both manual controls are released before the successive operations.

D. Two hand manual controls shall be provided for each operator where pinch points or other movement hazards are exposed to the operating personnel.

H7.1.9 On vertical or inclined slides or rams, means shall be provided to prevent rapid drop when hydraulic power is shut off.

APPENDIX A

STANDARD GRAPHICAL SYMBOLS

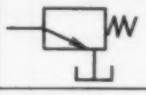
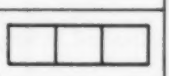
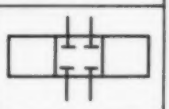
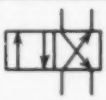
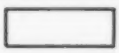
(From ASA-Y32.10)
(BASIC SYMBOLS CAN BE COMBINED IN ANY FORM DESIRED. NO ATTEMPT IS MADE TO SHOW ALL COMBINATIONS.)

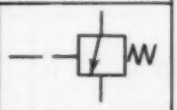
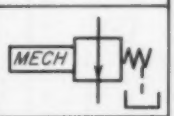
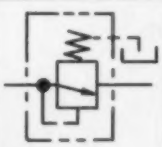
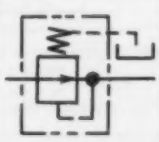
LINES AND LINE FUNCTIONS	
LINE, WORKING	
LINE, PILOT (L>20W)	
LINE, DRAIN (L<5W)	
CONNECTOR (DOT TO BE 5X WIDTH OF LINES)	
LINE, FLEXIBLE	
LINE, JOINING	
LINE, PASSING	
DIRECTON OF FLOW	
LINE TO RESERVOIR ABOVE FLUID LEVEL BELOW FLUID LEVEL	
LINE TO VENTED MANIFOLD	
PLUG OR PLUGGED CONNECTION	
TESTING STATION (GAGE CONNECTION)	TS
POWER TAKEOFF (HYD.)	PTO
RESTRICTION, FIXED	
RESTRICTION, VARIABLE	V

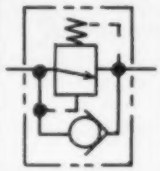
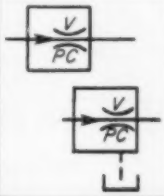
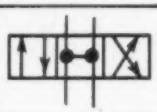
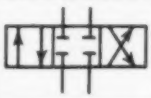
PUMPS	
PUMP, SINGLE, FIXED DISPLACEMENT	PF
PUMP, SINGLE, VARIABLE, DISPLACEMENT	PV

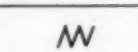
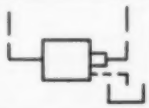
MOTORS AND CYLINDERS	
MOTOR, ROTARY, FIXED DISPLACEMENT	MF
MOTOR, ROTARY, VARIABLE DISPLACEMENT	MV
MOTOR, OSCILLATING	MO
CYLINDER, SINGLE ACTING	
CYINDER, DOUBLE ACTING SINGLE END ROD DOUBLE END ROD	

MISCELLANEOUS UNITS	
ROTATING SHAFT (ARROW IN FRONT OF SHAFT)	
COMPONENT ENCLOSURE	
RESERVOIR	
PRESSURE GAGE	
OTHER * Insert appropriate letter combinations and add appropriate symbols to indicate shafts or connecting flow lines. ACC ACCUMULATOR ELEC MOT ELECTRIC MOTOR ENG ENGINE FLT FILTER FM FLOW METER HE HEAT EXCHANGER INT INTENSIFIER PS PRESSURE SWITCH STR STRAINER TACH TACHOMETER	*

VALVES AND BASIC SYMBOLS	
VALVE, CHECK	
VALVE, MANUAL SHUTOFF	
VALVE, MAXIMUM PRESSURE (RELIEF)	
VALVE, BASIC SYMBOL SINGLE FLOW PATH IS MODIFIED.	
VALVE, BASIC SYMBOL MULTIPLE FLOW PATHS ARE CHANGED	
VALVE, SINGLE FLOW PATH, NORMALLY CLOSED	
VALVE, SINGLE FLOW PATH, NORMALLY OPEN	
VALVE, MULTIPLE FLOW PATHS, BLOCKED	
VALVE, MULTIPLE FLOW PATHS, OPEN (ARROWS DENOTE DIRECTION OF FLOW)	
VALVE, SPECIAL (IDENTIFY AND CONNECT ALL LINES)	

VALVE EXAMPLES	
VALVE, RELIEF REMOTELY OPERATED (UNLOADING VALVE)	
VALVE, DECELERATION NORMALLY OPEN	
VALVE, SEQUENCE, DIRECTLY OPERATED	
VALVE, PRESSURE REDUCING	

VALVE EXAMPLES (CONT.)	
VALVE, COUNTERBALANCE WITH INTEGRAL CHECK	
VALVE, FLOW-RATE CONTROL, VARIABLE, PRESSURE COMPENSATED	
VALVE, DIRECTIONAL, 2 POSITION 3 CONNECTION	
VALVE, DIRECTIONAL, 3 POSITION 4 CONNECTION OPEN CENTER	
VALVE, DIRECTIONAL, 3 POSITION 4 CONNECTION CLOSED CENTER	

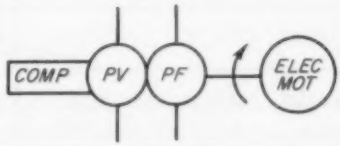
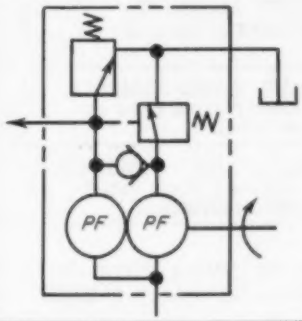
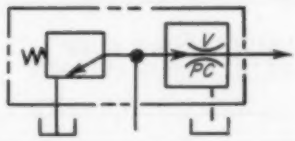
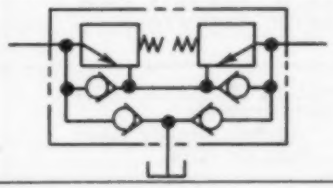
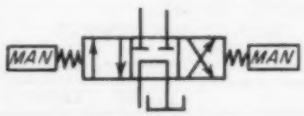
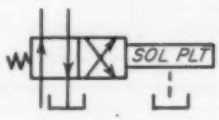
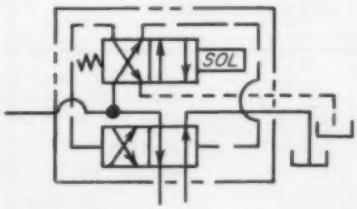
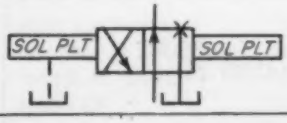
METHODS OF CONTROL	
SPRING	
PILOT OPERATED	
PILOT OPERATED, DIFFERENTIAL AREA	
OTHER	

* Insert appropriate letter combinations and add connecting flow lines.

CENT	CENTRIFUGAL
COMP	COMPENSATOR
CYL	CYLINDER
DET	DETENT
ELEC MOT	ELECTRIC MOTOR
HYD MOT	HYDRAULIC MOTOR
MAN	MANUAL
MECH	MECHANICAL
SERV	SERVO
SOL	SOLENOID
SOL PLT·	SOLENOID CONTROLLED, PILOT OPERATED
THRM	THERMAL

APPENDIX A (Continued)

STANDARD GRAPHICAL SYMBOLS

SAMPLE COMPOSITE SYMBOLS	
PUMP, DOUBLE, WITH ELECTRIC MOTOR ONE FIXED DISPLACEMENT ONE VARIABLE DISPLACEMENT WITH COMPENSATOR CONTROL	
PUMP, DOUBLE, WITH IN-BUILT CHECK, RELIEF AND UNLOADING VALVES.	
VALVE, PRESSURE COMPENSATED VARIABLE FLOW-RATE CONTROL WITH MAXIMUM PRESSURE CONTROL	
VALVE, RELIEF AND REPLENISHING	
VALVE, 4-WAY, MANUALLY CONTROLLED, SPRING CENTERED. (PORTING AT CENTER IS P TO T WITH CYLINDER PORTS BLOCKED)	
VALVE, 4-WAY SOLENOID CONTROLLED, PILOT OPERATED, SPRING OFFSET SIMPLIFIED SYMBOL COMPOUND SYMBOL	 
VALVE, 4-WAY, SOLENOID CONTROLLED, PILOT OPERATED, NO SPRING (ONE PORT PLUGGED)	

APPENDIX B FLOW RATE, PIPE WEIGHT, TUBING DIAMETERS AND WALL THICKNESSES (See H4.1.6 to H4.1.9 inclusive)

Operating Pressure (0 to 1000 psi)

8:1 Factor of Safety

*Flow Rate (gpm)	Valve Size	Pipe Schedule	Tubing Outside Diameter	Tubing** Wall Thickness
1	3/8	80	3/4	.035
1.5	3/8	80	5/8	.035
3	1/4	80	3/4	.035
6	3/8	80	1/2	.042
10	1/2	80	3/4	.049
20	3/4	80	1	.072
34	1	80	1 1/4	.109
58	1 1/4	80	1 1/2	.120

* Based on a maximum flow of 15 feet per second.
** Ultimate strength of material as calculated by Barlow's formula.

Operating Pressure (1000 to 2500 psi)

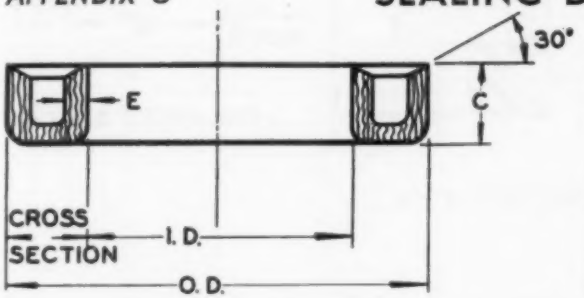
6:1 Factor of Safety
(Above 1/2 inch tubing, welded flange fittings, or fittings having metal to metal seals, or seals that seal with pressure are recommended.)

*Flow Rate (gpm)	Valve Size	Pipe Schedule	Tubing Outside Diameter	Tubing** Wall Thickness
2.5	1/4	80	3/4	.058
6	3/8	80	3/4	.095
10	1/2	80	3/4	.120
18	3/4	80	1	.148
30	1	80	1 1/4	.180
42	1 1/4	160	1 1/2	.220

Operating Pressure (Above 2500 psi)

4:1 Factor of Safety
(Welded flange fittings, or fittings having metal to metal seals, or seals that seal with pressure are recommended.)

APPENDIX C SEALING DEVICES



Nominal Sizes for Leather U Packings

Inside Diameter	Increment	Cross Section	C
1/2 thru 3/8	1/16	1/4	5/16
1 " 1 3/4	1/8	5/16	3/8
1 3/4 " 2 1/2	1/4	3/8	7/16
2 3/4 " 3 3/4	1/4	1/2	1/2
4 " 5 1/2	1/4	5/8	5/8
5 1/2 " 11	1/2	3/4	3/4
12 " 15	1	3/4	1
16 and over	1	3/4	*
*16" to 36"—1 1/4			
*37" & up —1 1/2			

Dash No.	Cross Section	Nominal Inside Diameter	Nominal Outside Diameter	C	E
12	3/4	1/2	1	5/16	1/8
14	3/4	5/8	1 1/16	5/16	5/16
16	1/4	3/4	1 1/8	5/16	1/8
18	1/4	7/8	1 3/16	5/16	1/8
20	3/8	1	1 5/16	3/8	5/16
22	3/8	1 1/8	1 3/8	3/8	5/16
24	3/8	1 1/4	2	3/8	5/16
26	3/8	1 3/8	2 1/16	3/8	5/16
27	3/8	1 1/8	2 1/4	3/8	5/16
28	3/8	1 5/8	2 5/16	3/8	5/16
29	3/8	1 3/4	2 1/8	3/8	5/16
30	3/8	1 7/8	2 7/16	3/8	3/8
31	1/8	2	3	1/8	3/8
32	3/8	2 1/16	3 1/16	1/8	3/8
33	3/8	2 1/4	3 1/4	1/8	3/8
34	3/8	2 3/8	3 3/8	1/8	3/8
36	3/8	2 1/2	3 1/2	3/8	3/8
38	3/8	2 3/4	3 3/4	3/8	3/8
40	3/8	3	4	3/8	3/8
42	3/8	3 1/4	4 1/4	3/8	3/8
44	3/8	3 1/2	4 1/2	3/8	3/8
46	3/8	3 3/4	4 3/4	3/8	3/8

Note 1: The above are nominal commercial sizes recommended for new designs. Other sizes for equipment already in use are available.

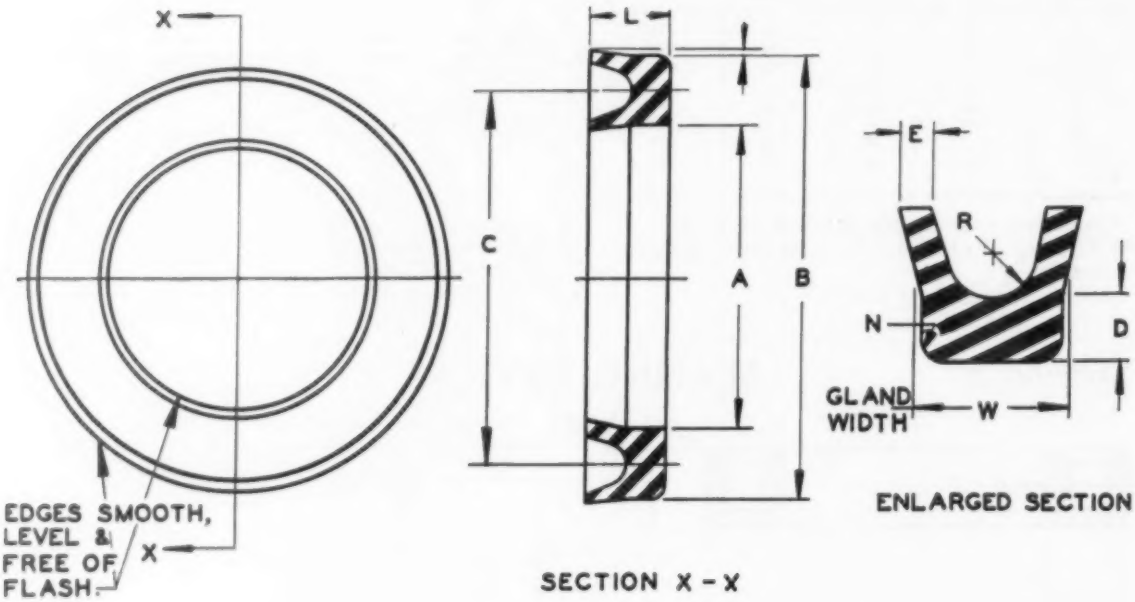
Dash numbers shown in this table are for reference only and apply specifically to this drawing.

Dash No.	Cross Section	Nominal Inside Diameter	Nominal Outside Diameter	C	E
49	5/8	4	5 1/4	5/8	5/16
50	5/8	4 1/4	5 1/2	5/8	5/16
51	5/8	4 1/2	5 3/4	5/8	5/16
52	5/8	4 3/4	6	5/8	5/16
53	5/8	5	6 1/4	5/8	5/16
54	5/8	5 1/4	6 1/2	5/8	5/16
55	5/8	5 1/2	6 3/4	5/8	5/16
56	3/4	5 1/2	7	3/4	5/16
58	3/4	6	7 1/2	3/4	5/16
60	3/4	6 1/2	8	3/4	5/16
62	3/4	7	8 1/2	3/4	5/16
64	3/4	7 1/2	9	3/4	5/16
66	3/4	8	9 1/2	3/4	5/16
67	3/4	8 1/2	10	3/4	5/16
68	3/4	9	10 1/2	3/4	5/16
69	3/4	9 1/2	11	3/4	5/16
70	3/4	10	11 1/2	3/4	5/16
71	3/4	10 1/2	12	3/4	5/16
72	3/4	11	12 1/2	3/4	5/16
74	3/4	12	13 1/2	1	5/16
76	3/4	13	14 1/2	1	5/16
78	3/4	14	15 1/2	1	5/16
80	3/4	15	16 1/2	1	5/16

Note 2: Materials and sizes shown are for guidance only when these types re used. It should not be construed that other types of packing are not aacceptable.

SEALING DEVICES

Nominal Sizes for Homogeneous U Packings



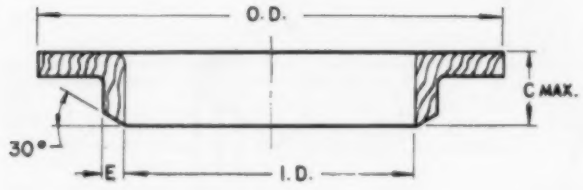
Dash No.	W & L	Nominal Size		Diameter ± .005			D	E	F	R	N
		I. D.	O. D.	A	B	C					
8	3/16	3/4	15/16	.265	.735	3/4	3/16	.045	.030	.070	1/16
10	3/16	7/8	1 1/16	.390	.860	7/8	3/16	.045	.030	.070	1/16
12	3/16	1	1 1/8	.515	.985	1	3/16	.045	.030	.070	1/16
14	3/16	1 1/8	1 5/16	.640	1.110	1 1/8	3/16	.045	.030	.070	1/16
16	3/16	1 1/4	1 7/16	.765	1.235	1 1/4	3/16	.045	.030	.070	1/16
18	3/16	1 3/8	1 9/16	.890	1.360	1 3/8	3/16	.045	.030	.070	1/16
20	3/16	1 1/2	1 11/16	1.015	1.485	1 1/2	3/16	.045	.030	.070	1/16
22	3/16	1 5/8	1 13/16	1.140	1.610	1 5/8	3/16	.045	.030	.070	1/16
24	3/16	1 3/4	1 15/16	1.265	1.735	1 3/4	3/16	.045	.030	.070	1/16
25	1/4	1 3/4	1 15/16	1.265	1.860	1 7/8	3/16	.050	.032	.093	1/16
26	1/4	1 7/8	2	1.390	1.985	1 15/16	3/16	.050	.032	.093	1/16
27	1/4	1 1/2	2 1/16	1.515	2.110	1 15/16	3/16	.050	.032	.093	1/16
28	1/4	1 5/8	2 1/16	1.640	2.235	1 15/16	3/16	.050	.032	.093	1/16
29	1/4	1 3/4	2 1/16	1.765	2.360	2 1/16	3/16	.050	.032	.093	1/16
30	1/4	1 7/8	2 1/16	1.890	2.485	2 1/16	3/16	.050	.032	.093	1/16
31	1/4	2	2 1/16	2.015	2.610	2 1/16	3/16	.050	.032	.093	1/16
32	1/4	2 1/16	2 1/16	2.140	2.735	2 1/16	3/16	.050	.032	.093	1/16
33	1/4	2 1/16	2 1/16	2.265	2.860	2 1/16	3/16	.050	.032	.093	"
34	1/4	2 3/16	3	2.390	2.985	2 15/16	3/16	.050	.032	.093	1/16
35	1/4	2 1/2	3 1/16	2.515	3.110	2 15/16	3/16	.050	.032	.093	1/16
36	3/16	2 3/16	3 1/16	2.515	3.235	2 3/16	3/16	.054	.035	.125	1/16
38	3/16	2 1/16	3 1/16	2.765	3.485	3	3/16	.054	.035	.125	1/16
40	3/16	3	3 1/16	3.015	3.735	3 1/16	3/16	.054	.035	.125	1/16

Note 1—Dash numbers shown in this table are for reference only and apply specifically to this drawing.

Note 2—Materials and sizes shown are for guidance only when these types are used. It should not be construed that other types of packing are not acceptable.

SEALING DEVICES

Nominal Sizes for Leather Flange Packings



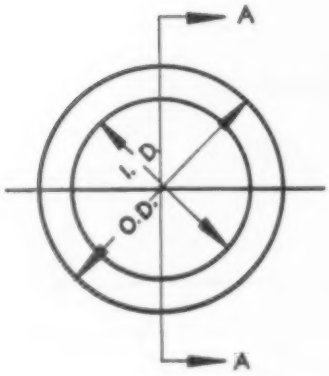
Dash No.	Inside Diameter	C	E		Maximum Outside Diameter
		Max.	Min.	Max.	
12	3/8	1/16	1/8	3/16	1 3/16
14	7/16	1/16			1 5/16
16	1/2	1/16			1 7/16
18	9/16	1/16			1 9/16
20	1	3/16			2
22	1 1/16	3/16	1/16	3/16	2 1/16
24	1 1/8	3/16			2 1/8
26	1 3/16	3/16			2 3/16
27	1 1/4	3/16			2 1/4
28	1 5/16	3/16			2 5/16
29	1 3/8	3/16	3/16	5/16	2 3/8
30	1 7/16	3/16			3
31	2	1/4			3 1/16
32	2 1/16	1/4			3 1/8
33	2 1/8	1/4			3 3/16
34	2 3/16	1/4	1/4	5/16	3 1/4
36	2 1/4	1/4			3 3/8
38	2 3/8	1/4			4
40	3	1/4			4 1/8
42	3 1/8	1/4			4 1/4
44	3 1/4	1/4	1/4	3/8	4 3/8
46	3 3/8	1/4			5
49	4	5/16			5 1/16
50	4 1/8	5/16			5 1/8
51	4 1/4	5/16			6 1/16
52	4 3/8	5/16	3/16	3/8	6 1/8
53	5	5/16			6 1/16
54	5 1/8	5/16			6 3/16
55	5 1/4	5/16			7 1/16

Note 1—The above are nominal commercial sizes recommended for new designs. Other sizes for equipment already in use are available.

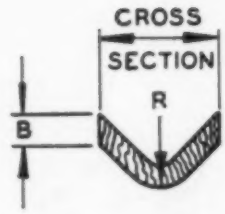
Note 2—Materials and sizes shown are for guidance only when these types are used. It should not be construed that other types of packing are not acceptable.

SEALING DEVICES

Nominal Sizes For Leather or Homogeneous "V" Packings



SECTION A-A



ENLARGED SECTION

Dimension "R" applies only to leather "V" packings.

The included angle for homogeneous "V" packings may vary slightly from 90°.

Dash numbers shown in this table are for reference only and apply specifically to this drawing.

Dash No.	Cross Section	Nom. Inside Dia.	Nom. Outside Dia.	B ±.010	R
8	1/4	1/2	3/4	.083	1/16
10	1/4	5/8	7/8	.083	1/16
12	1/4	3/4	1	.083	1/16
14	1/4	7/8	1 1/8	.083	1/16
16	1/4	1	1 1/4	.083	1/16
18	1/4	1 1/8	1 3/8	.083	1/16
20	1/4	1 1/4	1 1/2	.083	1/16
22	1/4	1 3/8	1 5/8	.083	1/16
24	1/4	1 1/2	1 3/4	.083	1/16
25	5/16	1 3/4	1 7/8	.140	3/16
26	5/16	1 7/8	2	.140	3/16
27	5/16	1 1/8	2 1/8	.140	3/16
28	5/16	1 3/8	2 1/8	.140	3/16
29	5/16	1 3/4	2 3/8	.140	3/16
30	5/16	1 7/8	2 1/2	.140	3/16
31	5/16	2	2 5/8	.140	3/16
32	5/16	2 1/8	2 3/4	.140	3/16
33	5/16	2 1/4	2 7/8	.140	3/16
34	5/16	2 3/8	3	.140	3/16
35	5/16	2 1/2	3 1/8	.140	3/16
36	3/8	2 1/4	3 1/4	.156	3/16
38	3/8	2 3/4	3 1/2	.156	3/16
40	3/8	3	3 3/4	.156	3/16
42	3/8	3 1/4	4	.156	3/16
44	3/8	3 1/2	4 1/4	.156	3/16

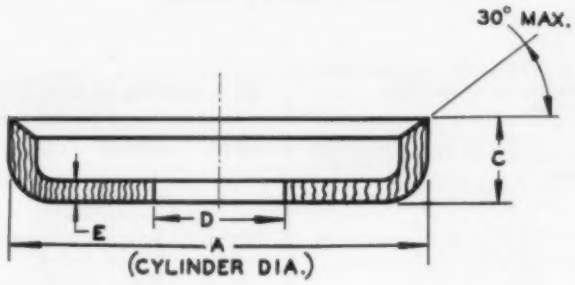
Dash No.[1]	Cross Section	Nom. Inside Dia.	Nom. Outside Dia.	B ±.010	R
46	3/8	3 3/4	4 1/2	.156	3/16
49	7/16	4	4 7/8	.197	3/16
50	7/16	4 1/4	5 1/4	.197	3/16
51	7/16	4 1/2	5 3/4	.197	3/16
52	7/16	4 3/4	5 7/8	.197	3/16
53	7/16	5	5 7/8	.197	3/16
54	7/16	5 1/4	6 1/8	.197	3/16
55	7/16	5 1/2	6 3/8	.197	3/16
56	7/16	5 3/4	6 1/8	.197	3/16
58	1/2	6	7	.197	3/16
60	1/2	6 1/2	7 1/2	.197	3/16
62	1/2	7	8	.197	3/16
64	1/2	7 1/2	8 1/2	.197	3/16
66	1/2	8	9	.197	3/16
67	1/2	8 1/2	9 1/2	.197	3/16
68	1/2	9	10	.197	3/16
69	1/2	9 1/2	10 1/2	.197	3/16
70	1/2	10	11	.197	3/16
71	1/2	10 1/2	11 1/2	.197	3/16
72	1/2	11	12	.197	3/16
74	1/2	12	13	.197	3/16
76	1/2	13	14	.197	3/16
78	1/2	14	15	.197	3/16
80	1/2	15	16	.197	3/16

Note 1—The above are nominal commercial sizes recommended for new designs. Other sizes for equipment already in use are available.

Note 2—Materials and sizes shown are for guidance only when these types are used. It should not be construed that other types of packing are not acceptable.

SEALING DEVICES

Nominal Sizes For Leather Cup Packings



Dash numbers shown in this table are for reference only and apply strictly to this drawing.

Dash No.	A	C Max.	D	E Min.	E Max.
1	5/16	3/16	To suit	1/16	1/16
2	3/8	3/16	To suit	1/16	1/16
3	7/16	3/16	To suit	1/16	1/16
4	1/2	3/16	To suit	1/16	3/16
5	11/16	3/16	To suit	1/16	3/16
6	3/4	3/16	To suit	1/16	3/16
7	13/16	3/16	To suit	1/16	3/16
8	7/8	3/16	To suit	1/16	3/16
9	15/16	3/16	To suit	1/16	3/16
10	1	1/8	To suit	1/16	3/16
11	1 1/16	1/8	To suit	1/16	3/16
12	1 1/8	1/8	To suit	1/16	3/16
13	1 3/16	1/8	To suit	1/16	3/16
14	1 1/4	1/8	To suit	1/16	3/16
15	1 5/16	1/8	To suit	1/16	3/16
16	1 3/8	1/8	To suit		
17	1 7/16	1/8	To suit		
18	2	1/8	To suit	1/16	5/16
19	2 1/16	1/8	To suit		
20	2 1/8	1/8	To suit		
21	2 3/16	1/8	To suit		
22	2 1/4	1/8	To suit		
23	2 5/16	1/8	To suit	1/16	5/16
24	2 3/8	1/8	To suit		
25	2 7/16	1/8	To suit		
26	3	5/16	To suit		
27	3 1/16	5/16	To suit		
28	3 1/8	5/16	To suit	1/16	5/16
29	3 3/16	5/16	To suit		
30	3 1/4	5/16	To suit		
31	3 5/16	5/16	To suit		
32	3 3/8	5/16	To suit		
33	3 7/16	5/16	To suit	3/16	5/16
34	4	5/16	To suit		
35	4 1/16	5/16	To suit		
36	4 1/8	5/16	To suit		
37	4 3/16	5/16	To suit		
38	5	5/16	To suit	3/16	5/16
39	5 1/16	5/16	To suit		
40	5 1/8	5/16	To suit		
41	5 3/16	5/16	To suit		
42	6	5/16	To suit		
43	6 1/16	5/16	To suit	3/16	5/16
44	6 1/8	5/16	To suit		
45	6 3/16	5/16	To suit		
46	7	5/16	To suit		
47	7 1/16	5/16	To suit		
48	7 1/8	5/16	To suit	3/16	5/16
49	7 3/16	5/16	To suit		
50	8	1	To suit		
51	8 1/8	1	To suit		
52	9	1	To suit		
53	9 1/8	1	To suit	3/16	5/16
54	10	1	To suit		
55	10 1/8	1 1/16	To suit		
56	11	1 1/16	To suit		
57	11 1/8	1 1/16	To suit	3/16	5/16
58	12	1 1/16	To suit		

Note 1—The above are nominal commercial sizes recommended for new designs. Other sizes for equipment already in use are available.

Note 2—Materials and sizes shown are for guidance only when these types are used. It should not be construed that other types of packing are not acceptable.

Note 3—Recommended dimensions shown are contingent upon observance of the maximum diametral clearances between back follower plate and the cylinder wall.

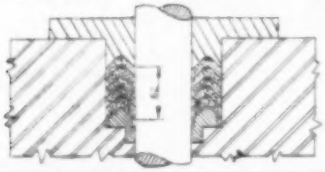
SEALING DEVICES

Code for Sealing Devices

(1) JIC STANDARD VEE PACKING-NO ADAPTERS

LV-40-62

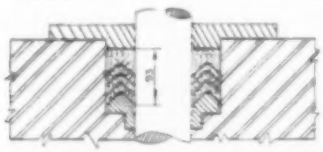
MATERIAL (LEATHER) | TYPE OF PKG (MULTIPLE LIP NO ADAPTERS) | JIC STANDARD PART NO (EQUIV IN SIZE TO AN6225-40) | NOM CONTACT HT OF PKG MEASURED ALONG THE ROD



(2) JIC STANDARD VEES & FEMALE ADAPTER

FVT-40-93

MATERIAL (FABRIC REINFORCED) | TYPE OF PKG (MULTIPLE LIP FEMALE ADAPTER ONLY) | JIC STANDARD PART NO (EQUIV IN SIZE TO AN 6225-40) | NOM CONTACT HT OF PKG MEASURED ALONG THE ROD



(3) VEES & MALE ADAPTER ONLY (NON-STANDARD SIZE)

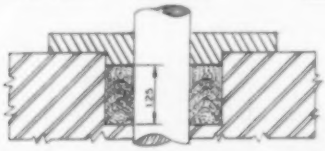
HVB-3.12 X 3.87-68

MATERIAL | TYPE OF PACKING (MULTIPLE LIP MALE ADAPTER ONLY) | NOM I.D OF PKG | NOM O.D OF PKG | NOM HEIGHT OF PACKING SET MEASURED ALONG THE ROD

(4) JIC STANDARD VEES & BOTH ADAPTERS

LVA-40-125

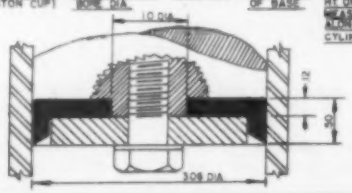
MATERIAL (LEATHER) | TYPE OF PKG (MULTIPLE LIP BOTH ADAPTERS) | JIC STANDARD PART NO (EQUIV IN SIZE TO AN 6225-40) | NOM CONTACT HT OF PKG MEASURED ALONG THE ROD



(5) CUP PACKING (NON-STANDARD SIZE)

HC-3.06 X 1.00 X .12-.50

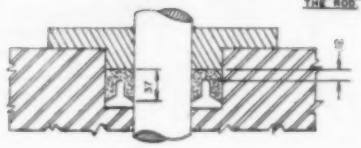
MATERIAL | TYPE OF PKG (PISTON CUP) | NOM CYLINDER BORE DIA | HOLE DIA | THICKNESS OF BASE | NOM CONTACT HT OF PKG MEASURED ALONG THE CYLINDER



(6) U-PACKING, NO ADAPTERS (NON STANDARD SIZE)

LU-3.12 X 3.87 X .12-.37

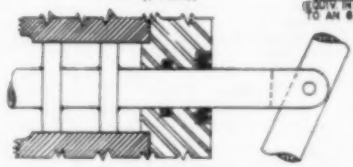
MATERIAL (LEATHER) | TYPE OF PKG (U-PACKING) | NOM I.D OF PKG | NOM O.D OF PKG | NOM HEIGHT OF PACKING SET MEASURED ALONG THE ROD



(7) JIC STANDARD O-RING PACKING

HO-40

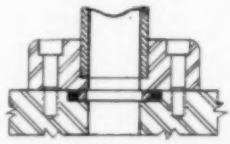
MATERIAL | TYPE OF PKG (O-RING) | JIC STANDARD PART NO (EQUIV IN SIZE TO AN 6227-40)



(8) JIC STANDARD O-RING GASKET

HS-25

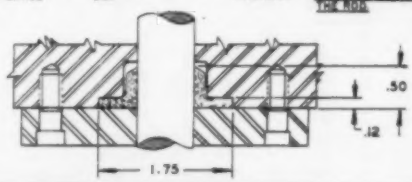
MATERIAL | TYPE OF PKG (O-RING GASKET) | JIC STANDARD PART NO (EQUIV IN SIZE TO AN 6230-25)



(9) FLANGE PACKING-(NON STANDARD SIZE)

FF-.75 X 1.75 X .12-.50

MATERIAL | TYPE OF PKG FLANGE | NOM ROD DIA | NOM OD | FLANGE THICKNESS | NOM CONTACT HT MEASURED ALONG THE ROD



JIC CODE FOR SEALING DEVICES

MATERIALS

- F—FABRIC REINFORCED
- H—HOMOGENEOUS (NAT. OR SYNTH)
- L—LEATHER
- M—METALLIC
- X—SPECIAL

TYPE OF PACKING

- V—VEE RINGS ONLY
- VT—VEES & FEMALE ADAPTER
- VB—VEES & MALE ADAPTER
- VA—VEES & BOTH ADAPTERS
- C—CUP PACKING
- U—U-PACKING
- O—O-RING PACKING
- S—O-RING GASKET (STATIC SEAL)
- F—FLANGE PACKING
- X—SPECIAL
- W—WASHER

APPENDIX D

SEAMLESS LOW CARBON STEEL TUBING

Annealed for Bending—Pressure Type

SCOPE

This specification covers cold drawn and annealed seamless low carbon steel pressure tubing, for use as hydraulic lines.

HYDROSTATIC TEST

Tubing supplied under this specification shall have been tested at not less than 1,000 lbs. hydrostatic pressure, or higher in case working conditions require.

CLEANLINESS

It is desired that the inside of tubing shall be bright, clean and free from grease, drawing compounds, oxide, scale, carbon deposits, and any contamination that cannot be readily removed by cleaning with alkaline cleaners or benzine.

CORROSION PROTECTION OF INTERIOR OF TUBES

The inside of the tubing having open ends shall be protected by a coating of clean oil to protect the interior of the tubing against corrosion during shipment and normal storage periods.

The corrosion preventive oil used shall be such that after extended storage periods it can readily be removed with an alkaline cleaning solution or with benzine (stoddard solvent).

QUALITY

Tubing shall be free from defects and in accordance with the best commercial practice.

CHEMICAL COMPOSITION

The tubing shall conform to the following chemical analysis:

Carbon	0.08—0.18
Manganese	0.30—0.60
Phosphorus	0.050 Max.
Sulfur	0.055 Max.

PHYSICAL PROPERTIES

The tubing shall conform to the following physical requirements:

Tensile Strength	55,000 psi max.
Elongation in 2 in.	35%* min.
Rockwell Hardness	B65 max.

*For tubes with O.D. of ⅜ in. and/or wall thickness of 0.035 a minimum elongation of 30% is permitted.

A three inch section cut from the tubing shall not crack or show any flaws when flattened between parallel plates to three times the wall thickness of the tube.

A section of tube approximately four inches in length with the ends burred, shall withstand being expanded at one end over a polished tapered mandrel having an included angle of 60° until the actual average inside diameter is increased 30%.

Expansion Test—Shall be made in a die in order to restrict the expansion of 30%. The axis of the mandrel should be parallel to the axis of the tube during the expansion test.

VARIATIONS

The diameter of the tubing shall not vary from that specified more than the amounts shown in table.

Nominal Outside Diameter	O.D. Inches	I.D. Inches
¼ to ½ in., incl.	±0.003	—
Above ½ to 10 in., incl.	±0.005	±0.005
Above 1-½ to 3-½ in., incl.	±0.010	±0.010

When the outside diameter and wall thickness of ½ in. to 3½ in. O.D. tubes are specified, the outside diameter shall conform to the tolerances given in the above table. The wall thicknesses shall not vary from that specified more than ±10%. When less than ½ in. I.D., the outside diameter shall conform to the tolerances given in the above table. The wall thickness shall not vary from that specified more than ±15%.

PICKLE BRITTLENESS

Tubing which is pickled to remove scale shall be treated to eliminate pickle brittleness.

APPENDIX E

WELDED STEEL TUBING

GENERAL

This specification covers cold worked and annealed electric resistance welded low carbon steel pressure tubing with outside diameter $\frac{3}{8}$ in. to $2\frac{1}{2}$ in., inclusive, for use as hydraulic lines for industrial equipment or other applications requiring flaring and bending.

CHEMICAL COMPOSITION (percentage by weight)

Carbon	0.18 max.
Manganese	0.30—0.60
Phosphorus	0.050 max.
Sulfur	0.055 max.

MECHANICAL PROPERTIES

The tubing shall conform to the following requirements:

Tensile Strength	55,000 psi max.
Elongation in 2 In.	35%* min.
Rockwell Hardness	B65 max.

*For tubes with O.D. of $\frac{3}{8}$ in. and/or wall thickness of 0.035, a minimum elongation of 30% is permitted.

Flattening Test—A section at least three inches in length shall be taken from every 1500 feet or less of finished tubing and shall be flattened between parallel plates to three times the wall thickness of the tube. The weld shall be placed at a point of 90 degrees from the direction of applied force. Any cracking or flaws revealed by this test shall be cause for rejection. Superficial ruptures resulting from minor surface imperfections shall not be cause for rejection.

Reverse Flattening Test—A section at least four inches in length shall be taken from every 1500 feet or less of finished tubing and split longitudinally 90 degrees on each side of the weld and the sample opened and flattened. There shall be no evidence of cracks or lack of penetration or overlaps resulting from flash removal in the weld.

Expansion Test—A suitable specimen shall be taken from each 1500 feet or less of tubing and subjected to an expansion over a plug. The outside diameter must be expanded 25 per cent throughout a length equal to the outside diameter of the tubing or one inch, whichever is greater. There shall be no evidence of cracking in this test.

Pressure or Electrical Test—Tubing supplied under this specification shall have been hydrostatically tested at a fiber stress of 20,000 psi or at an actual pressure of 5,000 psi, whichever is less, based on the applicable minimum wall, or tested by use of a nondestructive electrical test approved by purchaser.

DIMENSIONS

When tubing is specified by outside diameter and inside diameter, the tolerances shown in the table shall apply.

Nominal Outside Diameter	O.D. Inches	I.D. Inches
$\frac{3}{8}$ in.	±0.002	±0.006
Over $\frac{3}{8}$ in. to $\frac{1}{2}$ in. inclusive	±0.0025	±0.0025
Over $\frac{1}{2}$ in. to 2 in. inclusive	±0.003	±0.003
Over 2 in. to $2\frac{1}{2}$ in. inclusive	±0.004	±0.004

When tubing is specified by the outside diameter (or the inside diameter) and the nominal wall thickness, the tolerances for the specified diameter shall apply and the wall thickness shall not vary more than ± 10%.

QUALITY

Manufacture—The tubing shall be normalized and followed by a cold working operation. The cold working shall result in minimum reduction of area of 15%, of which at least 8% shall be reduction of wall thickness. After cold working the tubing shall be annealed in such a manner that the resultant product will meet all requirements of this specification.

Workmanship—Finished tubing shall be reasonably straight and have smooth ends free from burrs. There shall be no dimensional indication of welding flash. Tubing shall be free from injurious imperfections and shall have a workmanlike finish. Surface imperfections caused by handling marks, straightening marks, light die marks, or shallow pits are not considered injurious providing the imperfections are removable within the tolerance specified for diameter and wall thickness. The removal of such surface imperfections is not required.

Pickle Brittleness—Tubing which has been pickled to remove scale shall be treated to eliminate pickle brittleness.

Cleanliness—The inside of the tubing shall be commercially bright, clean and free from grease, drawing compounds, oxide scale, carbon deposits and any other contamination that cannot be readily removed with an alkaline cleaner or any cleaning solvent normally used in manufacturing plants.

PACKING & MARKING

Material shall be packaged and shipped as specified by the purchaser.

The inside and outside of the tubing shall be protected by a coating of clean oil so as to protect the exterior and interior of the tube against corrosion during shipment and normal storage periods.

The corrosion preventive oil used shall be such that after extended storage periods it can be readily removed with an alkaline cleaning solution or any cleaning solvent normally used in manufacturing plants.

Identification—All boxes, crates, cartons or bundles shall bear the following information: Purchase order number, specification number, manufacturer's names or identification symbol, outside diameter and wall thickness of material.

INSPECTION & REJECTION

While samples may be taken from incoming shipments and checked according to this specification, the vendor must accept the responsibility of meeting this specification without dependence upon the purchasers inspection which may be done at his option. The purchaser may request test certificates if desired.

Material failing to conform to these specifications or authorized modifications thereof is subject to rejection.

SAMPLE CIRCUIT DIAGRAMS

SEQUENCE OF OPERATIONS

1. With motor (4) running, valve (10) is shifted to position #1 directing flow from pump (3) through valves (10), (11B) & (12) to extend clamp cylinder (15).

2. Cam on (15) depresses valve (13B) near end of stroke and allows (11B) to open when pressure rises to its adjusted setting. Work cylinder (14) extends permitting valve (13A) to extend.

3. Valve (10) is shifted to position #3. Flow from (3) is through(10) & (11A) to retract (14).

4. Cam on (14) depresses (13A) near end of stroke & allows (11A) to open when pressure rises to its adjusted setting. (15) retracts permitting (13B) to extend.

Valve (10) is shifted to position #2. Flow from (3) is returned freely to tank through (10).

FUNCTIONAL DESCRIPTION

Valve (5) limits maximum operation pressure & provides overload protection.

Valve (10) controls direction of movement of cylinders (14) & (15).

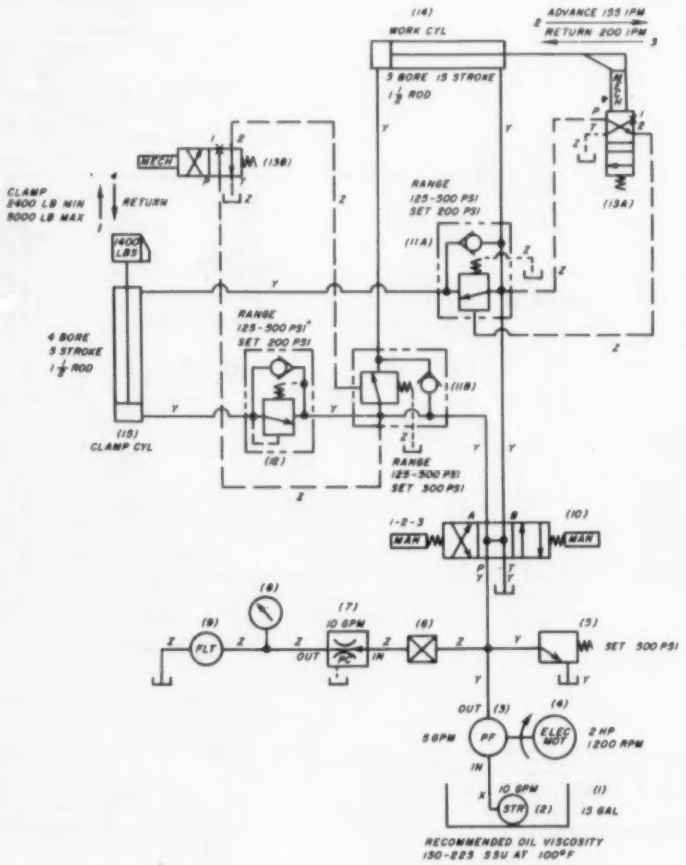
Valve (11B) causes operation #1 to precede operation #2 & assures minimum pressure equal to its setting in head end of (15) during operation #2.

Valve (11A) causes operation #3 to precede #4 & assures minimum pressure equal to its setting in rod end of (14) during operation #4.

Valves (13) are interlocks preventing premature opening of valves (11) & premature operation of cylinders (14) & (15).

Valve (12) affords counterbalance action for cylinder (15) preventing the piston from dropping when head end would otherwise be open to tank.

Valve (6) may be closed to permit clearing filter (9) while system is operating. Valve (7) bleeds off portion of pump flow for filtering. Gage (8) indicates when (9) requires cleaning.



COMPONENT LIST			
KEY	QUAN	NAME, MODEL NUMBER AND MANUFACTURER	
1	1	RESERVOIR	TU-12-341 JOHN DOE CO.
2	1	STRAINER	ST-10 JOHN DOE CO.
3	1	PUMP	VP-1AC-5 JOHN DOE CO.
4	1	MOTOR, ELECTRIC	EM-2312-220 ABC CORP.
5	1	VALVE, RELIEF	RV7A-34 JOHN DOE CO.
6	1	VALVE, SHUT OFF	GL-04 JOHN DOE CO.
7	1	VALVE, METERING	FL-120-PC JOHN DOE CO.
8	1	GAGE, PRESSURE	GS-1000-R JOHN DOE CO.
9	1	FILTER	FL-100-2 JOHN DOE CO.
10	1	VALVE, DIRECTIONAL, MANUALLY OPERATED	DV4-M30 JOHN DOE CO.
11	2	VALVE, SEQUENCE	SV-123 JOHN DOE CO.
12	1	VALVE, COUNTERBALANCE	CV-122 JOHN DOE CO.
13	2	VALVE, PILOT, MECHANICALLY OPERATED	DVP4-C2A JOHN DOE CO.
14	1	CYLINDER CUSHION ROD END	C3B-R15-CRE JOHN DOE CO.
15	1	CYLINDER	C4B-R3-V JOHN DOE CO.

C-1001-H

STEEL TUBING SIZE CODE

X = 7/8 O.D. x .072 wall
Y = 5/8 O.D. x .049 wall
Z = 3/8 O.D. x .035 wall

Installation shall conform to JIC Standards

Cycle Time 16 seconds min.

Equipment Serial No. 12345

Purchase Order No. 67890

SYM	DATE	SIGNED	DESCRIPTION
REVISIONS			

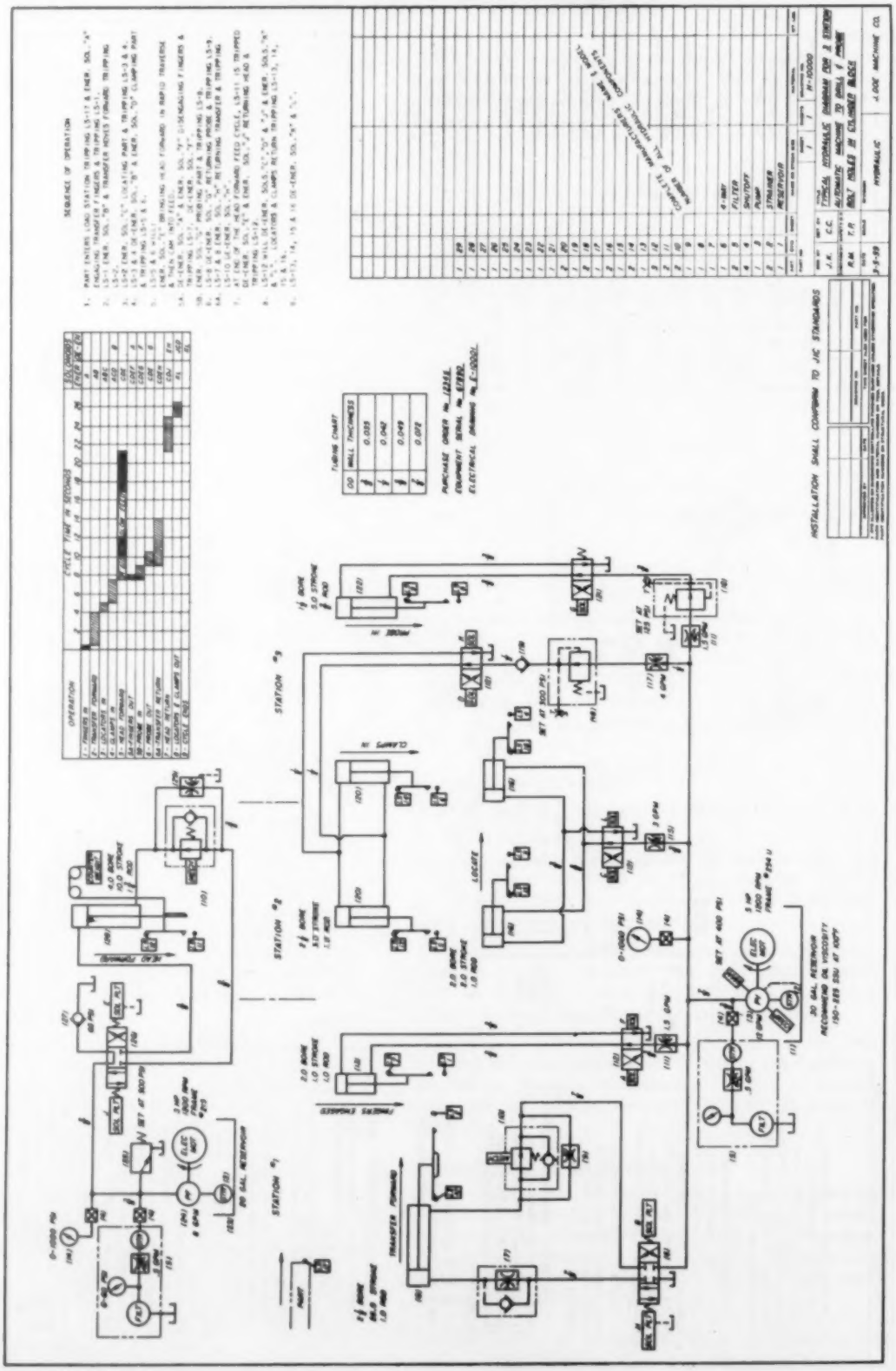
HYDRAULIC CIRCUIT DIAGRAM FOR ASSEMBLY PRESS

DRAWN BY: J.J.J. 5-6-55
APPROVED: L.L.L. 5-5-55

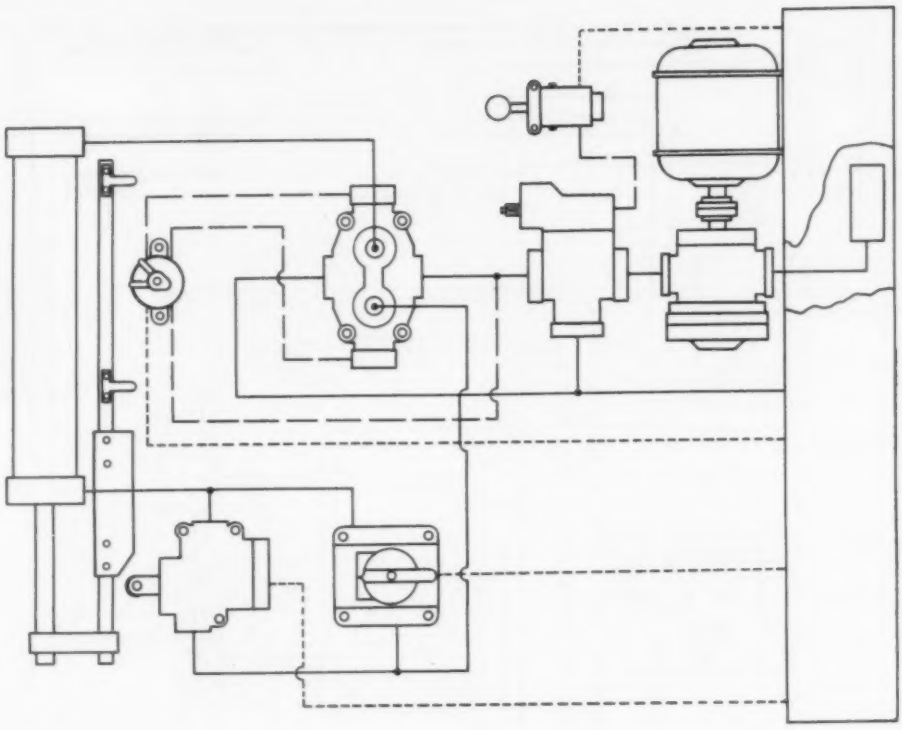
JOHN DOE COMPANY

DRAWING NO. C-1001-H
CONT ON SH no. FINAL

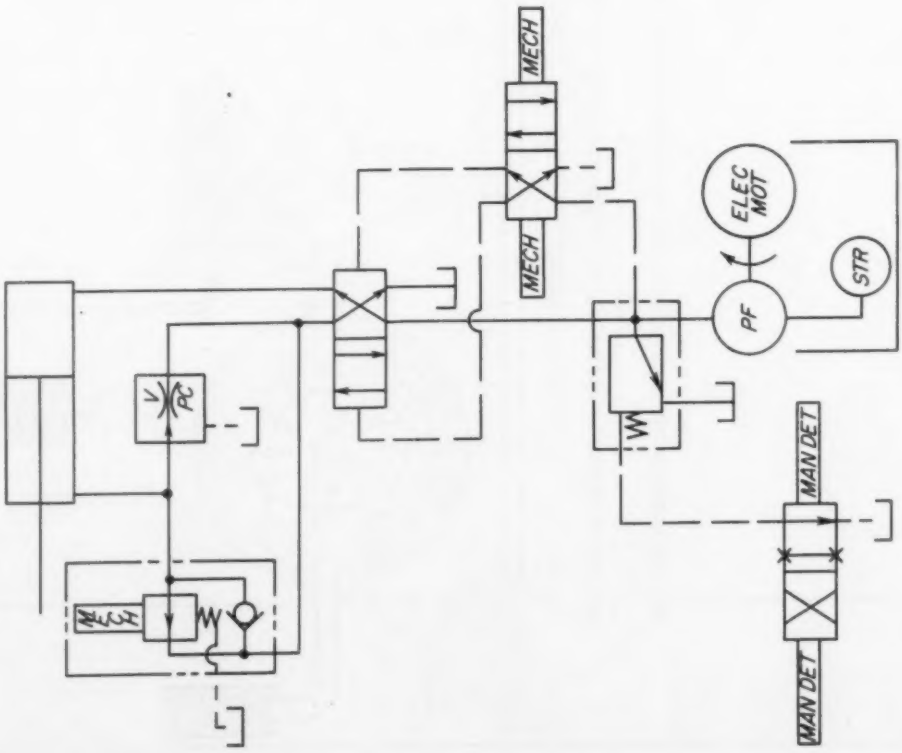
SAMPLE CIRCUIT DIAGRAMS



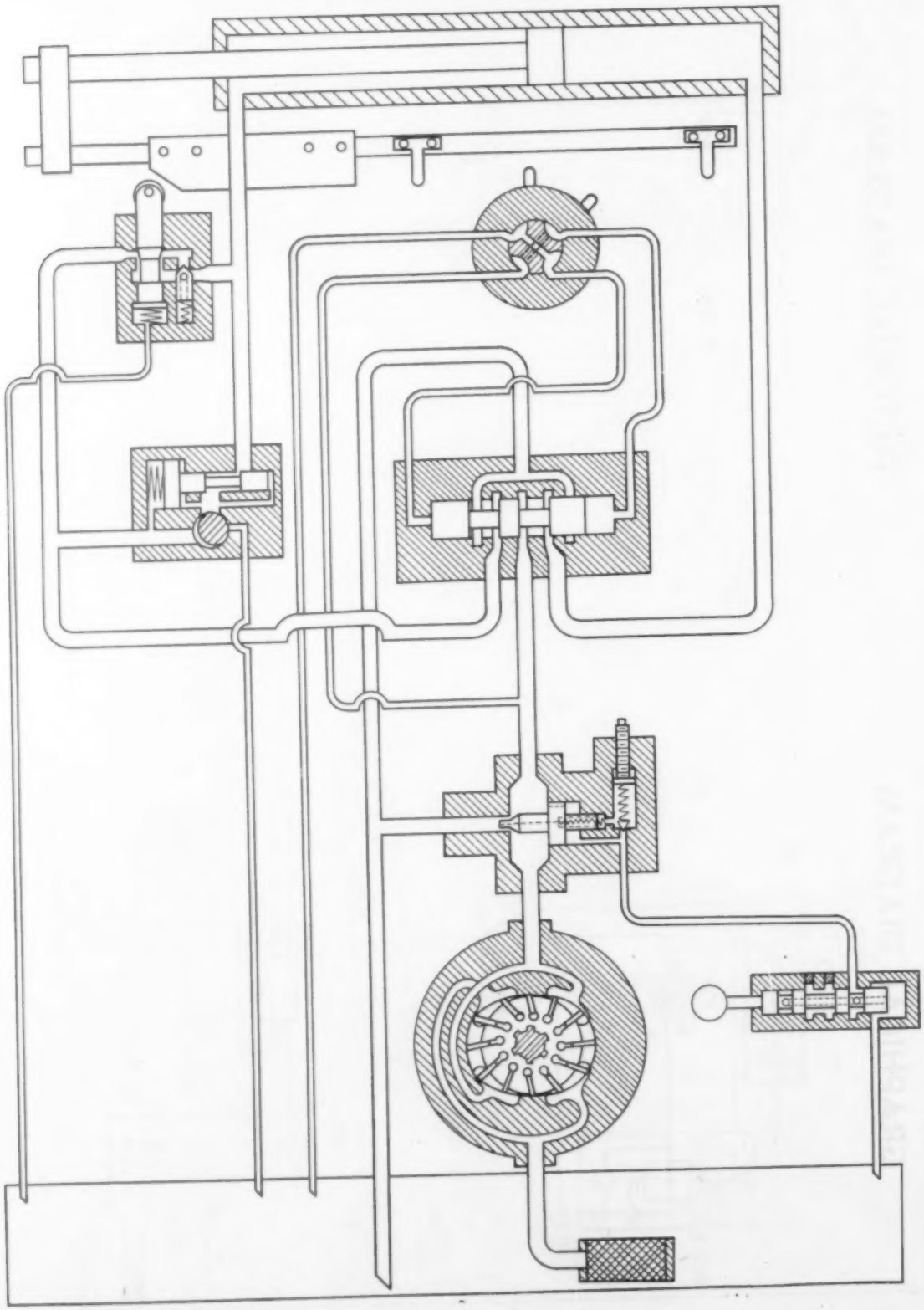
PICTORIAL DIAGRAM



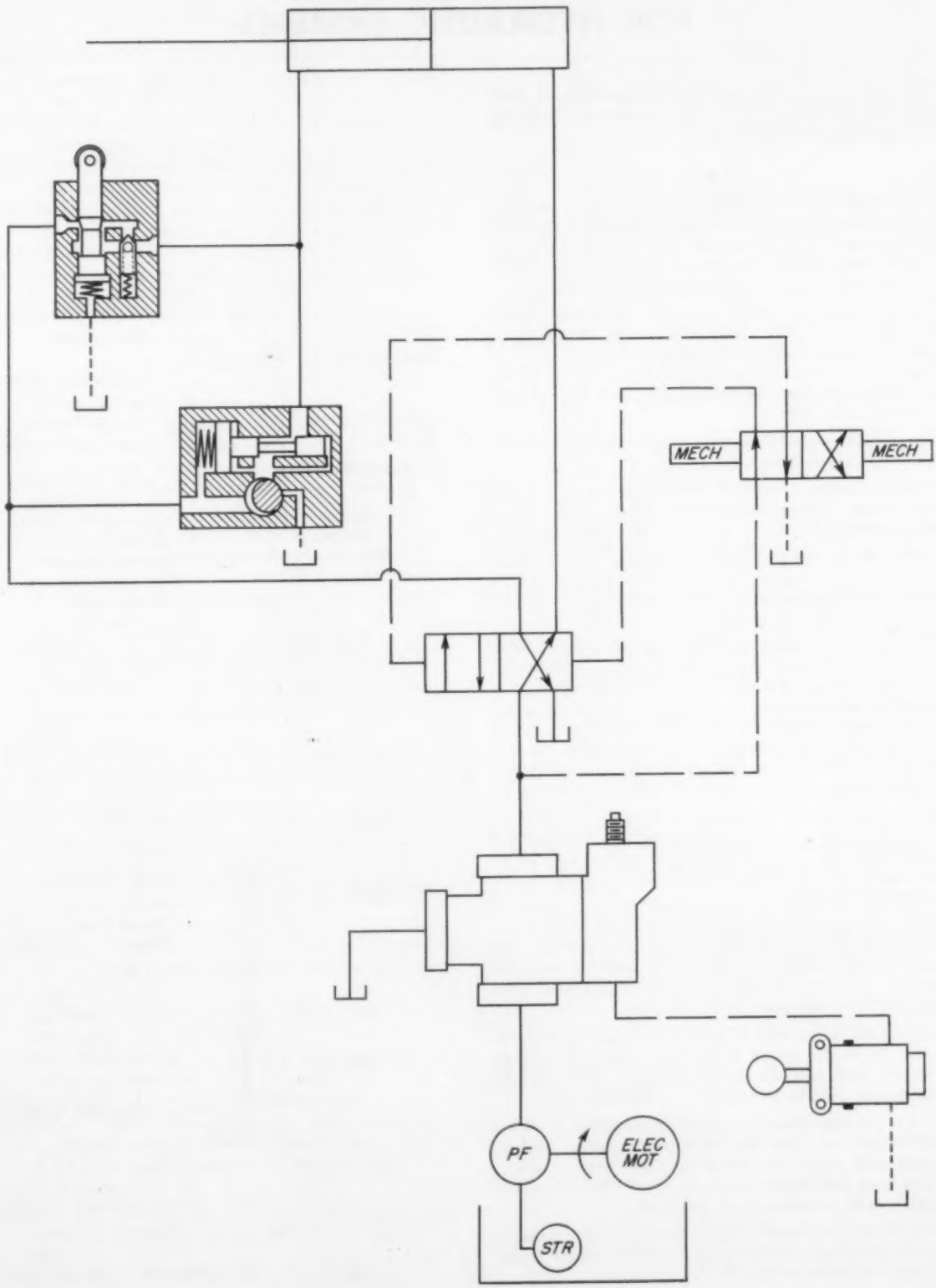
GRAPHICAL DIAGRAM



CUTAWAY DIAGRAM



COMBINATION DIAGRAM



APPENDIX H

PRESSURE REGULATORS AND RELIEF VALVE SPRINGS FOR HYDRAULIC SYSTEMS

This paragraph to be used for the guidance of plant maintenance personnel on the replacing of springs in hydraulic equipment.

Manufacturers recommended springs shall be used for replacement. When not immediately available substitute springs may be used in accordance with the following specification outlined. As soon as manufacturers springs are available they will replace the substitute springs.

Springs which are coiled from cold drawn wire should be made of G.M. 58-M. In general, the use of cold drawn wire should be restricted to wire diameters of .062" or less. Springs should be so designed as to limit loading to stresses of less than 80,000 lbs. per sq. in. total torsional fiber stress.

For springs made from wire larger than .062", G.M. 64-M should be used.

Springs should be carefully tested on accurate calibrating devices. The best of these are based on the following principles:

In this device, see Fig. I, an accurate scale has mounted upon it a sort of press ram actuated by rack and pinion with hand wheel so as to provide a means of applying pressure to load the spring.

The pan, or weighing platform, of the scale is fitted with a pin or other aligning means, upon which is set a fixture having a broad base for steady support; a shoulder on top of the base, fitted to the end of spring to be tested; and a post fitted to the inside diameter of the spring and ground on top so that the distance from the shoulder to the top of the post is within ±.001" of the working or loaded length of the spring.

To use this device, the fixture and spring are laid on the scale pan and the scale set to zero by the Tare adjustment. Then the dial test indicator is set to zero by means of a small flat surface block held against the bottom of the ram.

When the ram is forced down onto the spring, the spring is compressed and the dial test indicator indicates the exact loaded weight when the needle comes to zero. The weight, pressure, or load of the spring is then read directly from the scale dial.

Use of this device with various sizes of springs is facilitated if all the spring fixtures are close to the same weight. Then only the differing weights of the springs themselves must be tared to zero on the scale dial.

A less accurate device for weighing springs is marketed by several tool firms and comprises a spring weighing scale with means for compressing the springs and a graduated steel length measuring scale. This will suffice where high accuracy is not required.

Where only an occasional check is required and accuracy is not necessary, springs can be weighed with a simple device as shown in Fig. II.

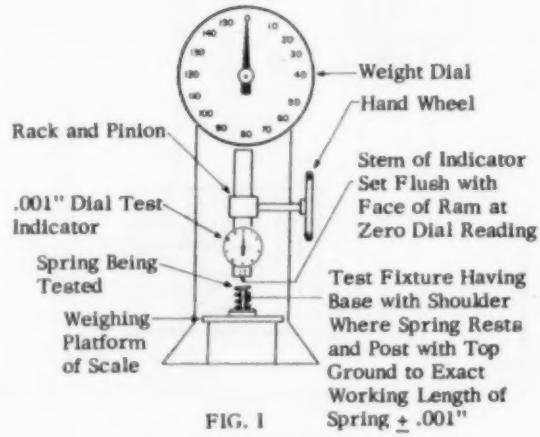

Weight Dial
Hand Wheel
Rack and Pinion
Stem of Indicator Set Flush with Face of Ram at Zero Dial Reading
.001" Dial Test Indicator
Spring Being Tested
Test Fixture Having Base with Shoulder Where Spring Rests and Post with Top Ground to Exact Working Length of Spring ± .001"
Weighing Platform of Scale

FIG. I

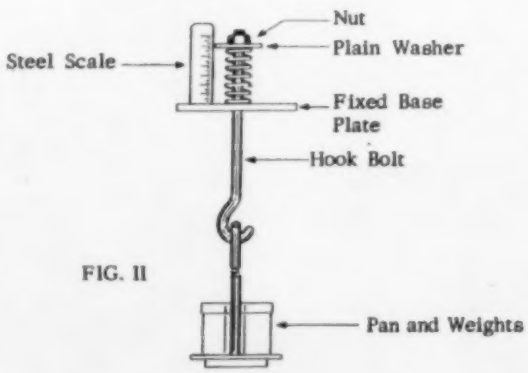


FIG. II

APPENDIX J

GLOSSARY

ACCUMULATOR: A storage chamber in which fluid energy may be accumulated and from which it may be withdrawn.

ACTUATOR: A device for converting fluid energy into mechanical motion.

BACK CONNECTED: Where connections are made to normally unexposed surfaces of components.

CHANNEL: A fluid passage the length of which is large with respect to its cross-sectional area.

CLARIFIER: A device for removing harmful materials which affect the properties of a fluid. A clarifier is usually an auxiliary unit.

COMBINATION DIAGRAM: A drawing utilizing a combination of graphical, cutaway, and pictorial symbols showing inter-connecting lines.

COMPARTMENT: A space within the base, frame or column of the equipment.

CONTROL: A device used to regulate the function of a component or system.

AUTOMATIC: A control which actuates equipment in a predetermined manner.

MANUAL: A control actuated by the operator.

CUTAWAY DIAGRAM: A drawing showing principal internal working parts of all hydraulic components, controls and actuating mechanisms, all interconnecting lines, and functions of individual components.

CYLINDER: A device for converting fluid energy into linear motion. It usually consists of a movable element such as a piston and piston rod, plunger, or ram operating within a cylindrical bore.

SINGLE ACTING: A cylinder in which the fluid force can be applied to the movable element in only one direction.

PLUNGER OR RAM TYPE: A cylinder in which the movable element has the same cross-sectional area as the piston rod.

PISTON TYPE: A cylinder in which the movable element has a greater cross-sectional area than the piston rod.

DOUBLE ACTING: A cylinder in which fluid force can be applied to the movable element in either direction.

SINGLE ROD: A cylinder with a piston rod extending from one end.

DOUBLE ROD: A cylinder with two piston rods, one extending from each end.

ENCLOSURE: A housing for components.

FILTER: A device through which fluid is passed to separate from it matter held in suspension. A filter is usually installed on the pressure side of a pump.

FRONT CONNECTED: Where connections are made to normally exposed surfaces of components.

GRAPHICAL (SCHEMATIC) DIAGRAM: A drawing or drawings showing each piece of hydraulic apparatus including all interconnecting lines by means of approved (ASA, JIC) standard symbols.

INTENSIFIER: A device which increases the working pressure over that of the primary pressure source.

LINE: A tube, pipe, or hose for conducting fluid.

DRAIN: A line returning leakage fluid independently to the reservoir or vented manifold.

EXHAUST: A line returning power or control fluid back to the reservoir.

PILOT: A line which conducts control fluid.

WORKING: A line which conducts power fluid.

LINES, JOINING: Lines which connect in a circuit.

PASSING: Lines which cross but do not connect in a circuit.

MANIFOLD: A conductor which provides multiple connection ports.

VENTED: A manifold which is open to the atmosphere and returns fluid to the reservoir.

MANUAL OVER-RIDE: A means of manual control over an automatic device.

METERED FLOW: Flow at a controlled rate.

MOTOR: A device for converting fluid energy into mechanical motion.

OSCILLATING: A motor which produces rotary motion usually less than 360°.

ROTARY: A motor capable of continuous rotary motion.

FIXED DISPLACEMENT: A rotary motor in which the displacement per revolution is constant.

VARIABLE DISPLACEMENT: A rotary motor in which the displacement per revolution can be varied.

PANEL: A plate or a surface for mounting components.

HYDRAULIC MOUNTING: A panel on which a number of hydraulic components may be mounted.

HYDRAULIC CONTROL: A grouping of hydraulic components mounted on a panel or integrally built into an assembled unit having a single mounting surface.

PASSAGE: A machined or cored fluid conducting path which lies within or passes through a component.

PHASES OF CYCLE:

0. Neutral
1. Rapid advance
2. Feed or pressure stroke (Forward and Return)
3. Dwell
4. Rapid return

RAPID ADVANCE: The phase of a cycle where tools or workpiece approach at high speed to the feed position.

FEED: The phase of a cycle where work is performed on the workpiece.

DWELL: The phase of a cycle where the feed is stopped for a predetermined length of time.

RAPID RETURN: The phase of a cycle where the tools or workpiece return at high speed to the cycle starting position.

PICTORIAL DIAGRAM: A drawing showing each component in its actual shape according to the manufacturer's installation.

PIPING: All pipe, tubing, hose, and fittings.

PORT: An internal or external terminus of a passage in a component.

PORT, VALVING: A controllable opening between passages i.e. one which can be closed, opened, or modulated.

POSITIVE POSITION STOP: A structural member which accurately stops motion.

POSITIVE SAFETY STOP: A structural member which confines maximum travel to safe limits.

PRESSURE: Force per unit area, usually expressed in pounds per square inch (psi).

PRESSURE-TIME DIAGRAM: A graphical presentation of pressure plotted against time for a complete cycle of the equipment.

PUMP: A device for converting mechanical energy into fluid energy.

FIXED DISPLACEMENT: A pump in which the displacement per cycle is constant.

VARIABLE DISPLACEMENT: A pump in which the displacement per cycle can be varied.

RESTRICTOR: A device for producing a deliberate pressure drop or resistance in a line by reducing the cross-sectional flow area.

CHOKE: A restrictor, the length of which is relatively large with respect to its cross-sectional area.

ORIFICE: A restrictor, the length of which is relatively small with respect to its cross-sectional area.

1. Fixed
2. Variable

VARIABLE: 1. Non-compensated
2. Pressure compensated
3. Pressure and temperature compensated

SEALING DEVICE: A device used to prevent fluid leakage.

STRAINER: A device through which a fluid is passed to separate from it solids held in suspension. A strainer is usually installed on the intake side of a pump.

SUB-PLATE (BACK PLATE): An auxiliary ported plate for mounting components.

SURGE: A momentary rise of pressure in a circuit.

TRIP DEVICE: A mechanical element for actuating a position control.

UNIT PRODUCTION: One piece per setup.

VALVE: A device which controls fluid flow conditions such as pressure, direction, time, or rate.

APPENDIX K

REFERENCES TO OTHER CODES AND STANDARDS

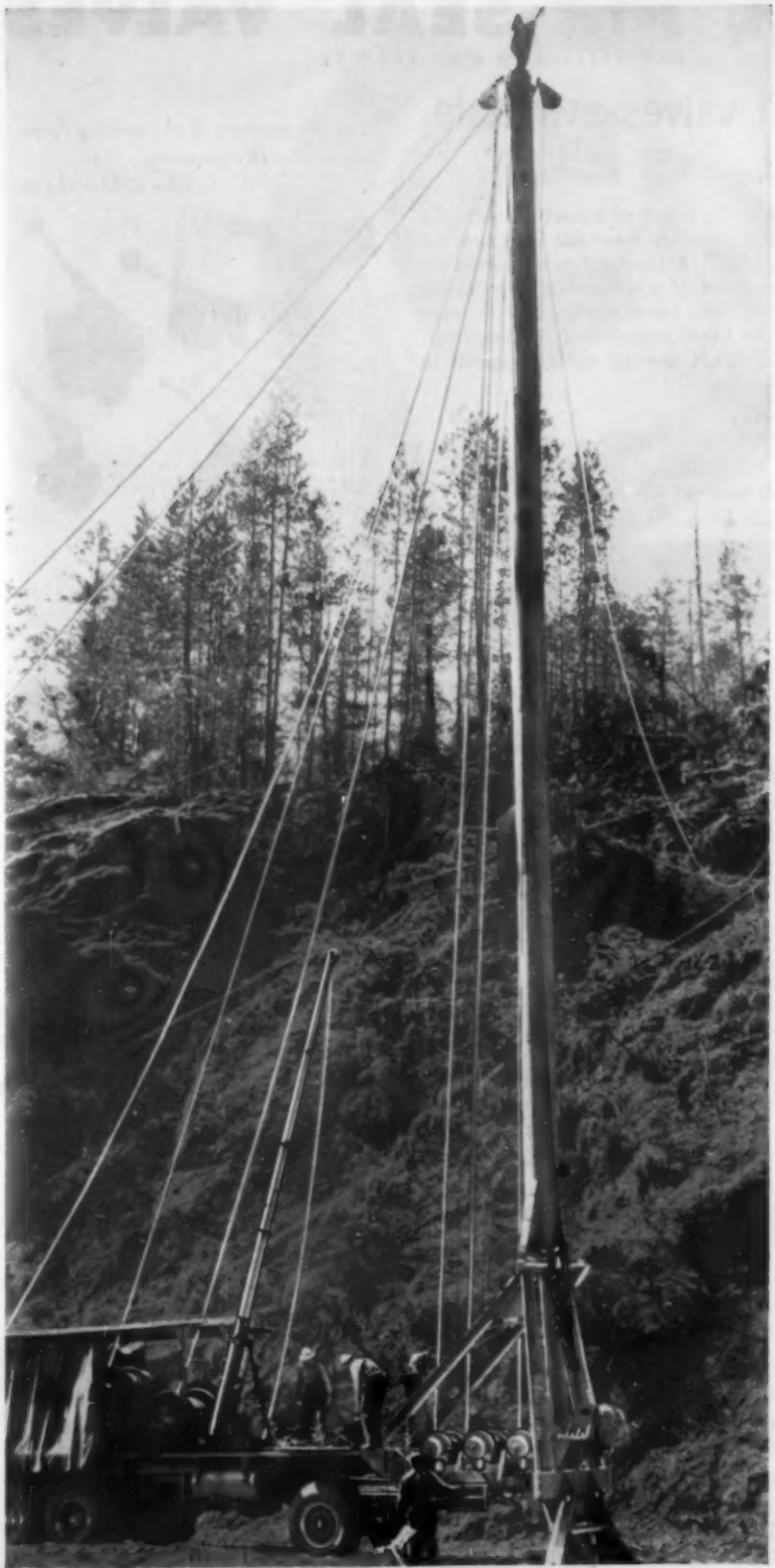
American Standards Association
70 West 45th Street, New York 17, New York
Y14.17 . . . American Drafting Standards Manual
Y32.10 . . . Graphical Symbols for Fluid Power Diagrams

Superintendent of Documents
Government Printing Office, Washington, D. C.
MIL-F-5506 . . . . . Method of Testing Fittings
MIL-F-5509 . . . . . Fittings, Fluid Connections

American Society for Testing Materials
260 South Broad Street, Philadelphia 2, Penna.
A106 Grade B . . . Seamless Carbon Steel Pipe for High Temperature Service

Office, Secretary of Defense
Defense Supply Management Agency
Washington 25, D. C.
MS 33584 . . . . Standard Dimensions for Flared Tubing

759



COMMERCIAL FLUID POWER COMPONENTS give the Madill Mobile Spar speed and flexibility that reduces a 12 hour operation to only 2 hours. Fluid power piped from 2 hydraulic pumps to 9 directional control valves in tandem actuates (a) the cylinder that raises and lowers the spar, (b) 2 leveling jacks, and (c) 6 hydraulic motors driving 6 winches.

Growing a 90 Ft. Spar Tree with Fluid Power

In the second-growth forests of the Pacific Northwest, spar trees have become mighty scarce. Taller and stronger than the trees surrounding, each spar was trimmed and rigged with block and tackle and winch to drag out all timber cut in the forest about it. Preparation time: about 12 hours. Today, the rugged, fast moving Madill Mobile Steel Spar is performing the same job in only 2 hours. Unusual hydraulic circuiting developed in cooperation with COMMERCIAL engineers powers the equipment.

The 86' by 24" tubular spar is raised fast and smoothly from horizontal to a 60° angle by a COMMERCIAL 5-stage, double-acting cylinder. Capable of developing an initial thrust of 70,000 lbs. on the push stroke, under oil pressure of 1500 psi, the cylinder extends 248". At this point the cylinder is unpinned from the spar and the rig's hydraulic-driven winches pull the spar into full perpendicular position.

The weight of the spar, in raised position, is transferred to the ground through the tailgate fitted with two COMMERCIAL double-acting hydraulic leveling jacks.

Fluid power also increases stability of the Madill Spar. Six single line guys are kept at required tautness by six reduction winches, each powered by individual hydraulic motors. Snapped guylines are prevented by an automatic pressure relief at 1500 psi.

COMMERCIAL cylinders, pumps, motors and valves involve fewer wearing parts than mechanical drives, eliminate vibration and, also important, can be easily mounted and piped in less space. A call to COMMERCIAL for design help will bring over 30 years experience to your assistance. Just write to Commercial Shearing & Stamping Company, Dept. A-27, Youngstown 1, Ohio.

COMMERCIAL
FLUID POWER COMPONENTS

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LOW PRESSURE AIR TO 250 P.S.I.

. . . over 200 different valves available.

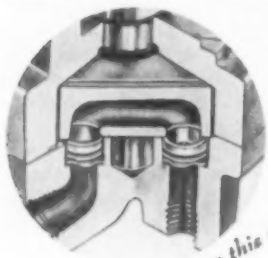
**The air pressure is the sealing force . . . the higher the pressure, the tighter the seal.*

Why so many different air valves?

Because air valve requirements vary with the method of actuation. A basic valve with interchangeable actuators cannot possibly meet ALL your specific applications without compromise. For example: A solenoid valve designed for speed would not have the stamina required of a manual or foot valve.

The Barksdale line of AIR-SEAL Valves has been designed with your requirements in mind. All our valves have been engineered for best performance from your point of view . . . for YOUR specific need, and not to make OUR job easier.

MANUAL and FOOT OPERATED "SHEAR-SEAL" VALVES



No oilers and filters needed — not critical to dirt and corrosion — made from non-corrosive materials.

Years of leakproof service — without constant maintenance — Self aligning "Shear-Seal" design compensates for normal wear.

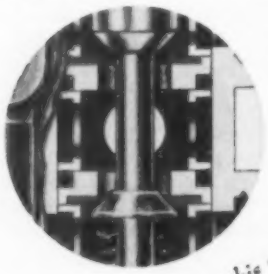
compare this with conventional

SPOOL or PLATE VALVES

Alignment is critical — dirt and corrosion cause sticking.

There is no compensation for normal wear — leakage increases with use.

SOLENOID-PILOT CRESCENT® (Self-aligning poppet) VALVES



Quick response (12 milliseconds) due to short travel of poppets and solenoid.

Tight sealing — self-aligning, self-scavenging design adjusts to normal wear — not critical to dirt and corrosion—non-corrosive materials throughout.

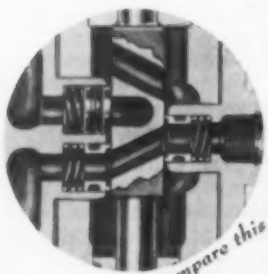
No coil burnout — heat dissipating "integral" design.

compare this with conventional

SPOOL VALVES

Slower response due to long spool travel. Leakage increases with use — dirt and corrosion particles are ground-in between spool and seals—Sticking! Overheating causes coil burnout — poor heat transfer of "unitized" design.

DIRECT-SOLENOID OPERATED "SHEAR-SEAL" VALVES



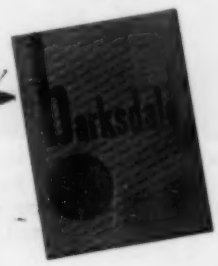
Leakproof for years of service — self-adjusting to wear. No coil burnout — because valve does not freeze up.

compare this with conventional

SPOOL VALVES

Dirt enters spool clearances — develops leaks — causes sticking — sticky valves are to blame for most solenoid burnout.

Write for Air Valve Catalog 9-AV



CONTROL VALVE DIVISION

Barksdale valves

5125 ALCOA AVENUE • LOS ANGELES 58 • CALIFORNIA

MANUALLY OPERATED

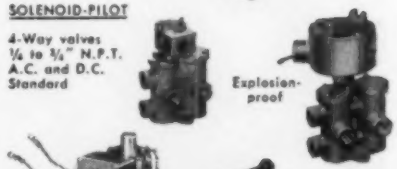
4-Way valves ¼ to 1½" N.P.T. with or without spring return

Shut-off valves ¼ to 1" N.P.T. with or without spring return

FOOT OPERATED

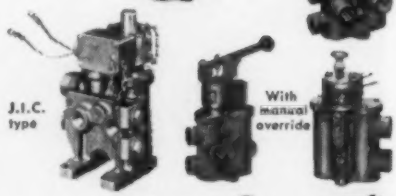
4-Way valves ¼, ⅜ and ½" N.P.T. with or without spring return

SOLENOID-PILOT



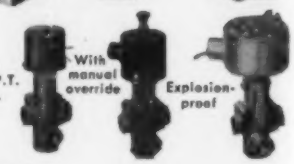
4-Way valves ¼ to ¾" N.P.T. A.C. and D.C. Standard

Explosion-proof



J.I.C. type

With manual override

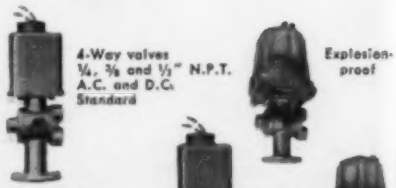


3-Way valves ¼ to ¾" N.P.T. A.C. and D.C. Standard

With manual override

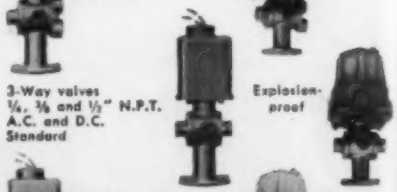
Explosion-proof

DIRECT SOLENOID



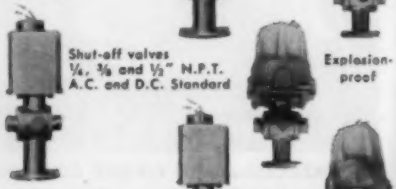
4-Way valves ¼, ⅜ and ½" N.P.T. A.C. and D.C. Standard

Explosion-proof



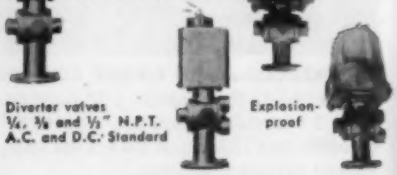
3-Way valves ¼, ⅜ and ½" N.P.T. A.C. and D.C. Standard

Explosion-proof



Shut-off valves ¼, ⅜ and ½" N.P.T. A.C. and D.C. Standard

Explosion-proof



Diverter valves ¼, ⅜ and ½" N.P.T. A.C. and D.C. Standard

Explosion-proof

titeflex flexible hose made for the toughest design jobs

It is now possible to design fluid transfers that would have been impossible until recently. Here are examples of TITEFLEX advances in the flexible hose field:

ITEM: Springfield "400"* Teflon hose in diameters to 2" . . . convoluted by an exclusive process to produce unique flexibility . . . minimum bend radius only 3½ times hose diameter!**

ITEM: "Zero-motion" braiding . . . a TITEFLEX process that also reduces chafing of braid wire, and wear to minimum. Elongation or contraction at operating pressure less than ½ of 1%!

ITEM: Springfield "140" Teflon Hose Assemblies . . . with reusable fittings . . . factory or field installed!

ITEM: Springfield "110" Teflon Hose Assemblies . . . guaranteed against fitting blow-off at their specified temperatures and pressures!

TITEFLEX is found wherever design problems are toughest. Details and specifications are as close as your phone. Your TITEFLEX distributor is in the yellow pages, or contact TITEFLEX direct.

titeflex

*T.M. of Titeflex, Inc., Patent Pending **Reg. T.M. of duPont

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LAkeside 8-0517

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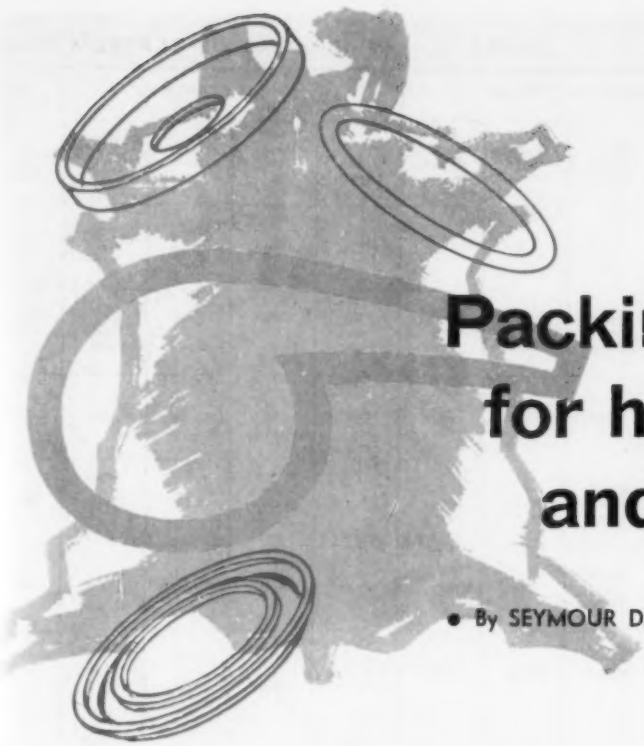


Packing materials for hydraulics and pneumatics

• By SEYMOUR DATZ, *Associate Editor*

PACKING wear, and replacement downtime can be cut considerably if you understand the limitations and characteristics of packing materials. The demands of your system—pressures and temperatures, fluid, and smoothness of sealing surfaces determine which is the best packing material for the job. Here are the materials marketed for use in hydraulic and pneumatic components, along with the application information for each type.

SYNTHETIC RUBBER

Oil-resistant synthetic rubber flows in a manner similar to fluids under high pressures, but it tends to resist the flow at the same time. The amount of resistance varies with the rubber composition as well as the shape of the packing. When pressure is removed, the synthetic rubber packing resumes its original shape, to a great extent. These important properties make rubber ideal for ring seals of the U-cup, O-ring and V-ring configurations. Synthetic rubbers are available in five basic classes for compounding into packing elastomers:

a. Butadiene-Styrene—Resembles natural rubber in most aspects. Swells in oils and reverts and dissolves in hot oil. Useful in water—glycol base fluid to 3,000 psi tensile strength. Commonly called GR-S.

b. Acrylonitrile—Resistant to petroleum, vegetable and animal oils. It is the most commonly used synthetic rubber in hydraulic systems. Shrinking or swelling is slight depending on the aromacity of the oil. Retains its desirable properties to 350°F and is resilient to —75°F when properly compounded. Excellent resistance to all fluids except for the synthetic esters. Tensile strength to 3,000 psi. Good abrasion and tear resistance. Sometimes known as Buna-N.

c. Chloroprene—Better known as Neoprene. These rubbers have good resistance to heat, abrasion, sunlight, and ozone. Fair to good resistance to all fluids except synthetic esters. Service temperatures range from —70°F to 250°F. Compression-set and tear-and abrasion-resistance are good. Tensile strength to 3,000 psi.

d. Butyl—Impermeability to gases and water are the major advantages of this material. Excellent for water-glycol and synthetic ester based fluids, Butyls show poor resistance to petroleum oils. Temperature ranges from —65°F to 300°F are operational for this rubber. Compression-set is fair, flame resistance poor.

e. Polysulfide—More familiar as Thiokol. These elastomers are noted for their high resistance to chemicals, petroleum oils, organic solvents and most hydraulic fluids. Limitations: poor moisture resistance, low strength and inferior heat resistance. Temperature range extends from —65°F to 160°F.

f. Silicones—This material is compounded for use over a wide range of temperatures, remaining stable from —110°F through 525°F. Strength and petroleum resistance are low. Compatibility with synthetic esters is fair. Compression set is the lowest of all known elastomers over the full temperature range. Silicone rubber contains no soluble plasticizers, a major cause of seal shrinkage in most fluids.

Summing up, when basic synthetic rubbers are compounded with other ingredients, they undergo

TABLE 1 — PROPERTIES OF ELASTOMERIC

MATERIAL	Resilience	Elongation	COMPATABILITY OF FLUIDS: Petroleum Base	Water Glycol Base	Synthetic Ester	Water Oil Emul.	Water & Sol. Oil	RESISTANCE TO — Flame	Swell in Oil	Water Absorbtion	Tear	Abrasion
BUTADIENE (GR-S)	Good	Good	Poor	Good	Poor	Poor	Fair	Poor	Poor	Good to Exc.	Fair	Good to Exc.
ACRYLONITRILE (BUNA-N)	Good	Fair	Exc.	Very Good	Good to Poor	Good to Exc.	Good to Exc.	Fair to Poor	Good to Exc.	Fair to Good	Exc. to Good	Good
CHLOROPRENE (NEOPRENE)	Good	Good	Good to Fair	Good	Poor	Fair	Fair	Exc.	Fair to Good	Good	Good	Exc.
BUTYL	Exc.	Poor	Poor	Good	Good to Poor	Poor	Poor	Poor	Poor	Exc.	Good	Good
POLYSULFIDES (THIOKOLS)	Good	Good	Exc.	Exc.	Good to Poor	Exc.	Exc.	Poor	Exc.	Fair	Poor	Poor
SILICONES	Good	Fair	Fair	Fair to Poor	Good	Fair	Fair	Fair	Fair to Poor	Fair to Good	Poor	Poor
FLUOROCARBONS	Good	Good	Exc.	Exc.	Exc.	Exc.	Exc.	Fair to Poor	Exc.	Exc.	Good to Exc.	Good
POLYACRYLATES	Poor	Good	Good	Fair to Poor	Fair to Exc.	Fair to Poor	Fair to Poor	Poor	Good	Poor	Fair	Fair

Information for this table was supplied by packing manufacturers. Properties of materials vary according to specific compounding.

considerable property changes. The exact recipe is determined largely by the specific application of the elastomer. Table I illustrates the overall ranges of some of these characteristics.

Commercially available synthetic rubber packings may be fabricated with cord reinforcement for added strength when heavy duty cycles require it. Shapes for static or dynamic seals are limited only by molding techniques.

FLUORO-ELASTOMERS

This group, consisting of trade names such as Kel-F, Teflon, Viton, etc., is a valuable source of material for high temperature application. Chemical resistance, high tensile strength and low friction are added benefits. Highly resistant to all known hydraulic fluids, the elastomers are stable from —320°F to 500°F depending upon the compounding. Abrasion and tear resistance are excellent. Generally used in aircraft systems, they are becoming increasingly popular in high performance industrial fluid power.

POLYACRYLATES

These have superior chemical resistance because they require no plasticizer. When plasticizers are added, they reduce strength as well as heat resistance. Vyram, Acrilon, and others are available with tensile strengths to 2,500 psi and withstand temperatures to 300°F. Compression set can vary from 30 to 95%. Blending and curing techniques can make considerable difference in mechanical properties.

Fluorocarbons and Polyacrylates have their physical and chemical packing information summarized in Table I.

LEATHERS

Mechanical leather packings offer many advantages as applied in hydraulic systems. Some of these are:

a. Durability
b. Low coefficient of friction.
c. Wide pressure range.
d. Nonabrasive
e. Mechanical strength.
f. Fluid compatibility.

Packing shapes available in leathers are V-rings, U-rings, cups, and flange packings. For hydraulic use, the leather is generally impregnated to meet specific requirements.

Synthetic resin impregnated packings are inert to petroleum base fluids. Excess impregnate must be removed from the packing to insure low friction. Differences between static and kinetic coefficients of fric-

MATERIALS

Air Permeability	Tensile Strength Psi	Hardness Range Dure "A"	Temperature Range °F	Compression Set	Natural Aging
Fair	3000	40 to 90	−70°F to 250°F	Good	Exc.
Good	3000	40 to 95	−75°F to 350°F	Exc.	Exc.
Good	3000	40 to 95	−70°F to 250°F	Exc.	Exc.
Exc.	2000	40 to 90	−65°F to 300°F	Fair	Exc.
Exc.	Under 1000	35 to 80	−65°F to 160°F	Poor	Exc.
Good	1500	40 to 85	−110°F to 525°F	Fair	Exc.
Exc.	1500 to 5000	50 to 90	−65°F to 500°F	Good	Exc.
Good	2500	50 to 100	−30°F to 300°F	Poor to Good	Exc.

Advantages of Leather Packings

1. Good abrasion resistance
2. Great tear and tensile strength
3. Low coefficient of friction
4. Resistance to various oil types
5. Low first cost
6. Long reliable life
7. Meets various operating conditions
8. Synthetic impregnation widens application
9. Tolerences to .005 inch

Advantages of Elastomeric Packings

1. Non porous
2. Easily molded to any shape
3. Strong chemical resistance
4. High operating temperatures
5. No break-in required
6. Wide hardness range
7. O-ring availability
8. Compounding varies properties to suit
9. Can be molded in small sizes

tion are slight—an advantage for slow speed pneumatic application. Leather packings have endured as much as 200 million feet of piston travel without measurable wear. Cold flow is low as compared with elastomers. If correct clearances are kept, leather tensile strength will be satisfactory. Tear and abrasion resistance is excellent.

Leather alone will absorb water and other fluids. Impregnation reduces fluid absorbancy making for good swelling properties in the packing. Synthetic rubber is now being used as an impregnant where more resiliency is desired. Excellent for petroleum base fluids or pneumatics service. Wax impregnants are suitable for lower temperatures and nonpetroleum fluids.

Tanning methods determine the operating temperatures for hydraulic leathers. Vegetable tanning will result in a 160°F maximum. Chrome tanning will yield 200°F before the leather chars and breaks down. Retanned leather is produced by a chrome tan followed by a vegetable retan, resulting in a 225°F maximum for 15-minute intervals.

METALS

For high temperature, high pressure aircraft service, metallic O-rings have proven successful as static seals. Filled with an inert gas, this packing rates excellent in its resistance to any hydraulic fluid, tear and abrasion, and flame. Water absorbtion and swelling in oil are not problems. Tensile strength sometimes exceeds 100,000 psi. Operating temperatures range from —300°F to 160°F. Industrial use is determined by excessive pressures and/or temperatures, as well as the cost factor. Available in stainless or cadmium plated mild steel of hollow torus shape, the interior is filled with 600-psi nitrogen. Metal O-rings are made in a full range of standard sizes. For lubricity, Teflon coating can be added. Silver plated O-rings are also available.

The precision type nonexpanding metallic seal is made for high temperature cylinder operation. Because of tight fit between piston and cylinder barrel, high efficiency and smooth operation are obtained with negligible oil leakage.

The metallic (automotive type) piston ring seals are ideal for fast cycling devices because of low leakage and friction losses. Low cost and maintenance are other advantages.

ASBESTOS

In the high temperature, soft packing field, asbestos in its many forms is a tough, durable, dimensionally

TABLE II—PROPERTIES OF IMPREGNATED PACKING MATERIALS

MATERIAL	Tolerance for Surface Roughness	Low Temperature Flexibility	CHEMICAL RESISTANCE		Resistance to Extrusion	High Temperature Limits	COMPATIBILITY WITH FLUIDS					Fabrication Cost Factor*
			Acid	Alkaline			Petroleum Base	Water-Gylcol Base	Synthetic Ester	Water-Oil Emulsion	Water and Soluble Oil	
LEATHER WAX-FILLED	Exc.	Poor	Good to Poor	Poor	Exc.	Vegetable Tan 180°F Mineral Tan 210°F	Some Waxes May Leach	Good	Poor (Leaching)	Good	Good	Simple Rings Require
LEATHER POLYSULFIDE-FILLED	Exc.	Exc.	Good to Poor	Poor	Exc.	Vegetable 180°F Mineral 200°F	Exc.	Good	Exc.	Exc.	Exc.	Simple Rings Required
FABRICATED COTTON-ASBESTOS WITH NEOPRENE OR BUNA-N	Good	Fair to Poor	Good to Fair	Good	Good	Cotton 250°F	Neoprene Good	Neoprene Good	Neoprene Poor	Neoprene Fair	Neoprene Fair	Mold is required for formed packings
						Asbestos 450°F	Buna-N Exc.	Buna-N Exc.	Buna-N Good to Poor	Buna-N Good to Exc.	Buna-N Good to Exc.	

Information for this table was compiled from a survey of the field. Impregnation techniques can vary some properties.

stable material. Relatively incompressible, asbestos fibers retain their strength to about 750°F. Resistance to shear and compression is excellent. To get the most out of asbestos, it is almost always used in combination with other products. Packing materials made of rubber-asbestos composition with a cloth binder are used for ambients to 450°F. For control valves, a braided asbestos impregnated with Teflon may be used. The addition of a lead core will make the packing frictionally stable over a longer period of time.

MISCELLANEOUS

Felts for wiper ring use are available in a wide range of hardnesses and fabricated sizes. Cork and rubber composition provides resiliency with compressibility. Cork composition with a resin binder makes a low cost, medium duty gasket. Metal clad elastomers are used for ring seals where the best properties of both materials are desired. Nylon fabric composition is used for the manufacture of cup rings.

FLUIDS AND LUBRICANTS

One of the most important factors in choosing a packing material is its compatability with the fluid being sealed. If the two are not chemically suited the system is twice endangered.

a. Packing material contaminates the fluid.

b. Seal efficiency is destroyed.

Regardless of how ideally a material is rated for your operating conditions, chemical compatibility is imperative.

In pneumatic systems using elastomeric seals, the lubricant used must neither attack the seal nor blow off when subjected to air pressure. Oil companies should be consulted if there is any doubt about this. □□□

Glossary Of Packing Material Terms

ACCELERATOR—A complex chemical added to the elastomer to speed up vulcanization of the compound.

ACRYLONITRILE — General class of Buna-N compounds.

ANTIOXIDANTS—Chemical added to elastomer to improve stability under heat.

BUTADIENE—Raw material used in the manufacture of a synthetic rubber.

BUTYL—A synthetic having excellent resistance to acids and low permeability.

CALENDERING — A process by which heated elastomers are squeezed for impregnating or fabric coating.

COMPRESSION SET — Residual thickness change of a material which has been subjected to compressive stresses.

CURATIVES — Organic chemicals which, with heat, stabilize the resultant elastomeric compound.

ELASTOMER — Any elastic material.

FILLER — Inert additive for improving abrasion resistance and strength.

FLEX LIFE—Fatigue life of material under flexural stress.

GR-S—A non oil resistant synthetic rubber.

LOAD DEFLECTION — Deformation of elastomer when under compression.

LOW TEMPERATURE BRITTLENESS—Loss of elasticity and resilience when material is subjected to low temperatures.

MECHANICAL BOND—One material secured to another by means of perforation, grooving, etc.

MODULUS—A die plate in which shapes have been cut. Under heat and pressure, a cured part is formed.

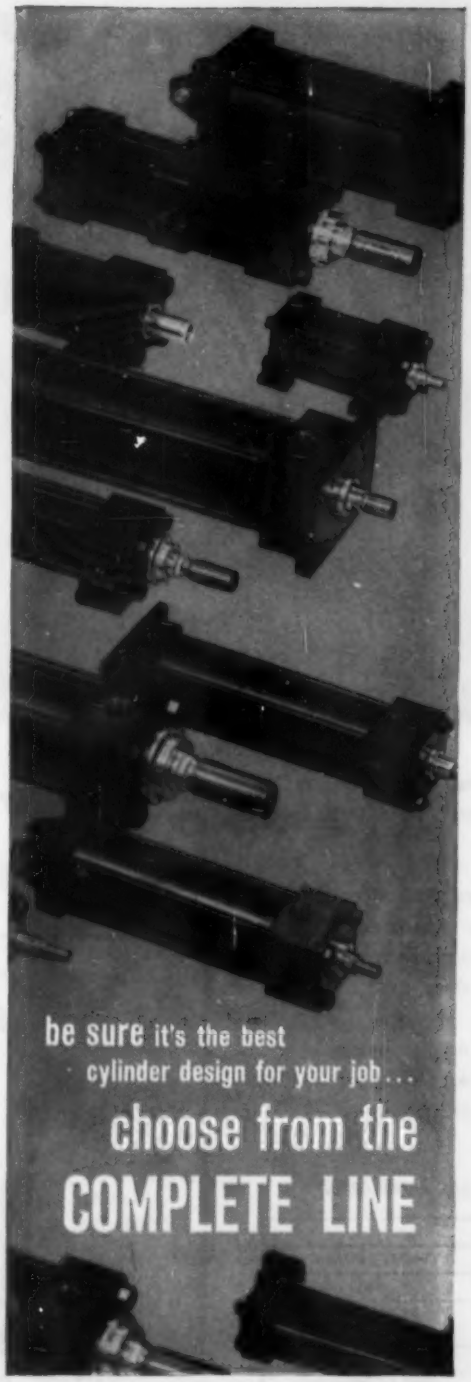
PERMANENT SET — Elongation after the material has been stretched, relieved and allowed to rest. Expressed as percentage of its original length.

PERMEABILITY — Property of a material allowing gases to pass through it.

PLASTICIZER—A fluid added to the basic material which controls hardness, plasticity and cold characteristics.

POLYMER—Elastomer having long, chain-like molecular structure.

ULTIMATE ELONGATION — The stretch produced by a tensile force applied at the moment of rupture.



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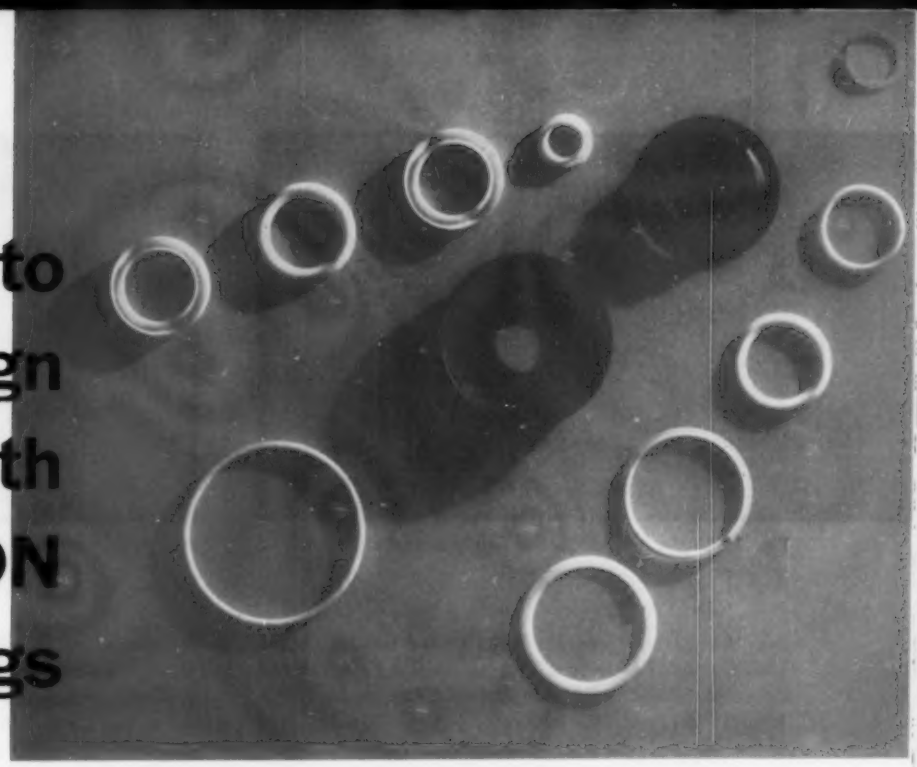


• By L. H. GILLESPIE
Polychemicals Department,
E. I. du Pont de Nemours & Co., Inc.,
Wilmington, Delaware

THE almost complete chemical inertness of Teflon* TFE-fluorocarbon resins led to their early use in seals of all types. Recognition of the wide temperature range at which this material is useful, plus the lowest coefficient of friction of any solid material has increased the use of seals of Teflon still further. Seals of TFE resins do not roll over, because they do not stick. Because no lubrication is needed, a possible source of contamination is removed. Since Teflon has considerably different properties than conventional seal materials, different design considerations must be included. The information in this article is intended to aid the designer in his use of Teflon. No attempt has been made to cover all possible modifications of basic seal design. Individual fabricators of TFE resins have their own variations on these designs.

LIP SEALS

Keep surface speed of unlubricated, rotating shafts below 600 fpm, because it's hard to remove the heat. Reciprocating shafts can be run a little faster, because some of the shaft is cooled a little on each stroke. Give both shafts a surface finish of not less than 16 rms.

• **Cup seals**—On hydraulic or pneumatic pistons where large clearances, less machining time, and simplicity of design are desirable, cup seals are used. Cups will seal statically and dynamically all the way up to 80,000 psi. In theory, the cup has full fluid pressure on its inside. The cylinder supports the cup's lip pressure. Less support comes from the wall near the heel and the cup itself carries the full inside load where the heel bridges the gap.

To insure lip contact and heel clearance, the cup has an outward flare. If the lip loses contact or is damaged, leakage past the cup can be very heavy. So, frequently for low pressures and shock loads, an expander such as a spring or rubber backing, is placed around the inside of the lip to force it against the cylinder. Care must be taken when installing lip seals not to damage the lip.

Figure 1 shows a typical single-acting and double-acting seal including the follower plate and base plate. For best results, put the full load of the pressure on the bottom of the cup and support it as shown.

Design the plunger with a shoulder cut on the bottom. That does two things. First it centers the cup on the plunger, and when the proper allowance for compression of the bottom is made, it prevents the cup from working loose under pressure. Secondly, undue compression of the cup base will bulge the cup's heel, make it bind against the cylinder wall, greatly reducing seal life. The shoulder should allow about 10% of the thickness of the cup bottom for compression. This permits proper compression of the

* Registered trademark of E. I. duPont Co. for their fluorocarbon resins including TFE resins.

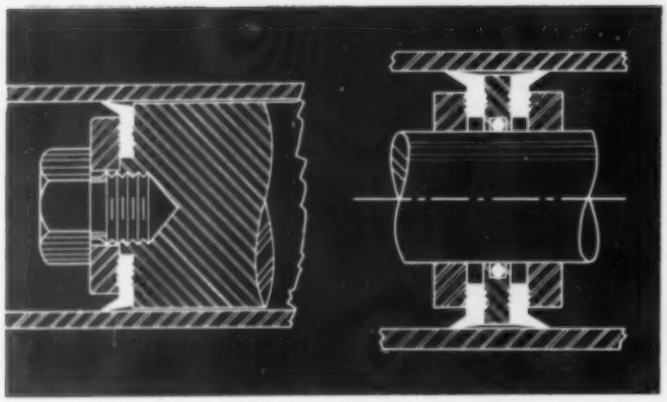


Fig. 1. Single and double acting cup installations.

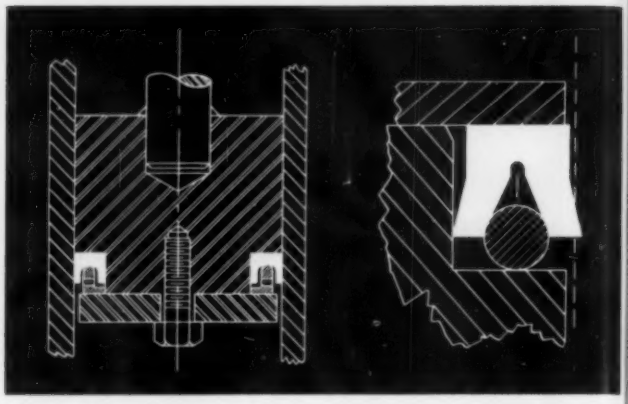


Fig. 2. U-ring seal assembly.

cup bottom and prevents leaks under the inside follower plate. To prevent unusual heel bulge, the follower plate and base plate should be serrated (.007" to .010" deep, 90°).

On simple jobs where shock loads do not occur and where the cost is not justified, do not shoulder the ram or back follower plate. However, do take extreme care during installation to compress the base of the cup correctly. Too much or too little will cause trouble. Because there's no shoulder height for a guide when tightening down the follower plate, the installation is trickier.

When you use shouldered piston rods, Figure 1B, install a static seal to prevent leakage along the rod. Then you won't have to use an expensive tapered piston rod and piston.

Make sure the spacer or back follower plate is a good fit in the cylinder, because this plate supports the cup heel. Too much clearance between the spacer and cylinder wall will wreck the cup quickly because the heel will extrude into the clearance gap. This is the most common cause of cup failure. Table I gives the preferred diametral clearances for spacers.

TABLE I

Diametral clearances for spacers used with cup seals.

Cylinder Diameter-in.	Clearance-in.	
	To 600 psi	Over 600 psi
1 to 3	.006	.004
3⅛ to 5	.008	.006
8½ to 10	.010	.008
10½ to 12	.012	.010

To prevent pinching the lip against the cylinder bore, keep the correct clearance for the inside follower plate. The clearance depends on the thickness of the heel and the heel clearance. The cup manufacturer usually specifies the clearance (Rule-of-thumb: the clearance between plate O.D. and cup I.D. should be about 25% of lip thickness.)

Make the plate deep enough to fill the space between the bottom of the cup and the inside beveled edge of the lip. Have a radius at the corner of the follower plate to avoid cutting the packing cup when it is in place. The cylinder surface rubbing the seal should have at least a 16-rms finish.

Many makers of seals furnish cup seals of Teflon in a complete range of sizes. They are made by machining, molding or postforming. If you use a machined or molded cup you should know the material's coefficient of expansion. If the operating temperature will vary more than 130 F you may need a spring or an initially tight fit to keep the lip against the cylinder. The reason is that heat expands Teflon. Confine the lip and the expansion will take place inwardly, around the lip thickness. On cooling, the lip will tend to shrink from the cylinder wall. The expander keeps the lip in contact.

Another solution is the use of postformed seals. They depend on the fact that parts made from Teflon will attempt to return to their original shape when heated. A seal formed from a flat sheet has stresses that make it press the cylinder wall as temperature increases. These stresses make up for problems caused by thermal cycling, and seals of this type have been used successfully at 450 F.

When you have to seal at low temperatures or if thermal contraction is too great, try reinforced Teflon. The reinforcing agents will reduce the coefficient of expansion considerably. For example, a seal with 15% glass additive will have only one-half the coefficient of expansion of an unadulterated TFE resin.

• **Rod Seals**—Rod or flange packings are like inverted cup seals. The same rules apply for them as for cup seals. They seal against a rod or plunger instead of against a cylinder. Rod seals are usually for small cross-sectional widths where a "U" or "V" type seal is not practical. The base area forms a gasket for a static seal when the follower is tightened. The inside surface thus forms an automatic seal against the piston rod or plunger.

This type of seal is used for either reciprocating or rotary motion. Its biggest advantage is the small space required.

• **U-Seals**—The U-seal is a combination of the cup and rod seal designs. The "U" is pressure driven not only against the mating moving surface but also

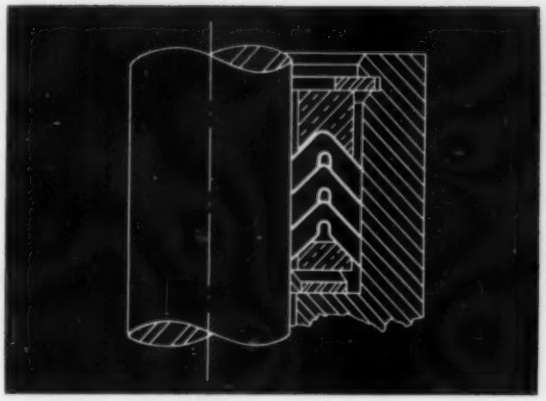


Fig. 3. V-ring seal assembly.

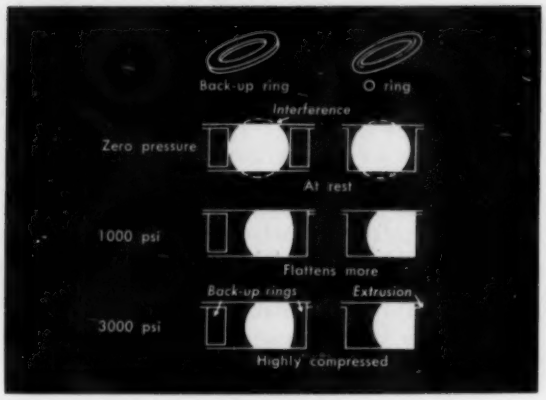


Fig. 4. Operation of an O-ring seal.

against the supporting walls of its recess. This does away with mechanical retention by bolts or retaining plates, because all you need is a positioner. Since this seal rests in a gland, more machining is necessary than for cup or rod seals.

Internal pressure to be sealed acts equally in all directions over the entire inner surface. Since pressure cannot escape, the packing is statically balanced and securely held. The flexible lips allow large interference to be built into the packing. The design permits gland assemblies which have wide variation in cross-sectional dimensions, and liberal manufacturing tolerances. Because of this, U-seals have been used successfully to eliminate excessive packing friction at low operating pressures without narrowing tolerances.

U-seals may be applied on piston rods to prevent the entrance of air into the cylinder. They may also be used as wiper rings to remove dirt and dust from rods.

Under no-load conditions, friction is very low because there is usually a clearance between the heel of the rings and the cylinder. As pressure increases, the heel is brought into contact with the cylinder and presses against it. There is always line contact between the tip of the lip and the cylinder, but with increased fluid pressure, more and more of the seal side comes into contact with the wall until the whole packing width is pressed against the wall.

U-seal friction varies directly with the pressure being sealed. No-load friction is very small, and at high pressure, the friction is much the same as for an equally wide rectangular packing of Teflon.

U-seals are made by machining, molding, or postforming. Don't use U-cups without mechanical expanders or support rings unless your analysis shows it will work.

To insure positive sealing action of the lips, most U-seals have metal support rings or rubber rings. They provide a resilient spreading action that forces the lips to seal under varying temperatures and pressures. With mechanical expanders the seals can take advantage of the wide use-temperature limits of Teflon. Support or throat rings also guard against collapse or distortion of the U-seal.

In designing U-seals: (1) The lip of the seal should never touch the bottom of the recess and should never touch the pedestal ring, ($\frac{1}{16}$" to $\frac{1}{8}$" clearance). See Figure 2. (2) The seal should have clearance between each side of the pedestal ring and the inside walls of the seal. This clearance is approximately 25% of wall thickness. (3) The nose of the pedestal ring should be shouldered to prevent cutting. (4) It is good practice to drill holes in the metal pedestal ring to assure that pressure is equalized on the inside walls of the lip.

• **V-Rings**—Another common type of automatic seal is the spring-actuated V-ring set shown in Figure 3. These rings resemble U-seals, but use more rings. The additional sealing edges lessen the danger of shutdown, because the next ring can take over when a ring fails or is damaged.

You can get male and female adaptors for the ends of the seals. Female adapters prevent the rings from deforming under extremely high pressures. Male adapters insure automatic lip action and a positive seal under pressure.

When considering a V-ring seal cross-section, you must give special attention to possible eccentricity limits, run-out, and misalignment in the assembled device. The greater the eccentricity or run-out, the greater the radial width of the seal must be to provide the necessary flexibility. Equipment in good alignment, seldom needs a V-ring seal more than $\frac{3}{8}$" wide.

To pick a V-ring seal set you need to know: (1) height or number of rings, (2) ratio of sealing lips to pressure, and (3) surface finish on both the moving part and static wall. With good finishes (at least 16 rms) and pressures below 500 psi, three V-rings are adequate. Higher pressures and rougher finishes need more sealing lips, up to 5 or 6 rings per set, plus female adapters. V-ring sets come in three types —molded, machined, and postformed.

SQUEEZE-TYPE SEALS

In general, O-rings seal effectively in wide ranges of temperatures and pressures and have the added ad-

vantage of sealing in both directions. They also save space.

Figure 4 shows how O-rings distort. The O-rings shown are rubber. Extrusion is their one drawback. Sometimes the fluid pressure forces the rubber to such an extent that it extrudes into the clearances. The degree of extrusion depends on pressure, clearance between supporting metal parts, and the hardness of the O-ring material. However, at low pressures, a softer O-ring material seals more effectively.

In designing O-ring seals, keep a minimum cross-section diametral interference or squeeze about 10% of the cross-section diameter in smaller sections. You may reduce to 5% in the larger section rings.

Break-away friction of rubber O-rings may be 50 to 100% higher than running friction, depending on lubrication, squeeze, surface finish, time, etc. This high friction can make a lot of trouble in low pressure systems. To reduce break-away friction, sometimes the squeeze is reduced below this minimum. In high pressure systems, attempts to reduce sliding friction by reducing squeeze will be neutralized since friction is high due to the extrusion of the O-ring into the groove end.

Decreasing the squeeze, may cause leaks, especially at low temperatures and pressures. When O-rings of Teflon are used, the friction is so much lower that decreasing the squeeze is of no real operational advantage.

High friction of rubber also causes twisting and spiral failure. In low pressure installations friction sometimes can be avoided by using double-acting back-to-back U-cup seals of Teflon or floating ring seals.

Another way around high friction, extrusion, and spiral twisting is back-up rings of Teflon. It is often recommended that two backup rings, one on each side of the rubber O-ring, be used where either reciprocating or rotary motion occurs.

These back-up rings will prevent extrusion of the O-ring, since they will not deform at the same rate as the rubber, but will deform enough to fill the clearance beyond the retainer. Some of the TFE resin will be deposited on the rubber O-ring as it moves about the groove, thus reducing the friction of the ring considerably, cutting down on spiral failures, and making ring removal easier. Experience shows that in dynamic service up to 4,000 psi, ordinary rubber O-rings with back-up rings of an unmodified TFE resin are excellent. With higher pressures, harder O-ring compounds, reduced working clearances, or back-up rings of reinforced TFE resins are usually used.

Of course, by using O-ring of Teflon, the need for back-up rings is lessened except in extreme high pressure and high temperature installations. However, rings of Teflon are not as resilient as rubbers.

Covered O-rings and enveloped O-rings made from TFE resins are now being manufactured. These modifications increase resiliency of Teflon.

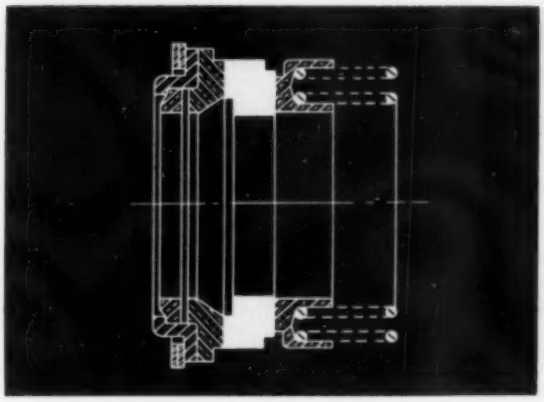


Fig. 5. Wedge seal for high temperatures and pressures.

When a small diameter O-ring of Teflon is to be fitted in an external groove, the stretch required to install the ring may permanently distort it, so that it will not fully snap back into position. If you heat the assembly to 600 F, plastic memory will cause the ring to return to its original size. Heating small rings prior to installation (i.e., immersing them in boiling water) will often make them plastic enough to assemble.

Another way to avoid stretching the ring is to cap the piston groove after the ring is inserted in a stepped shaft. A snap ring or threaded sleeve (such as with the cup seal used in Figure 1) will work.

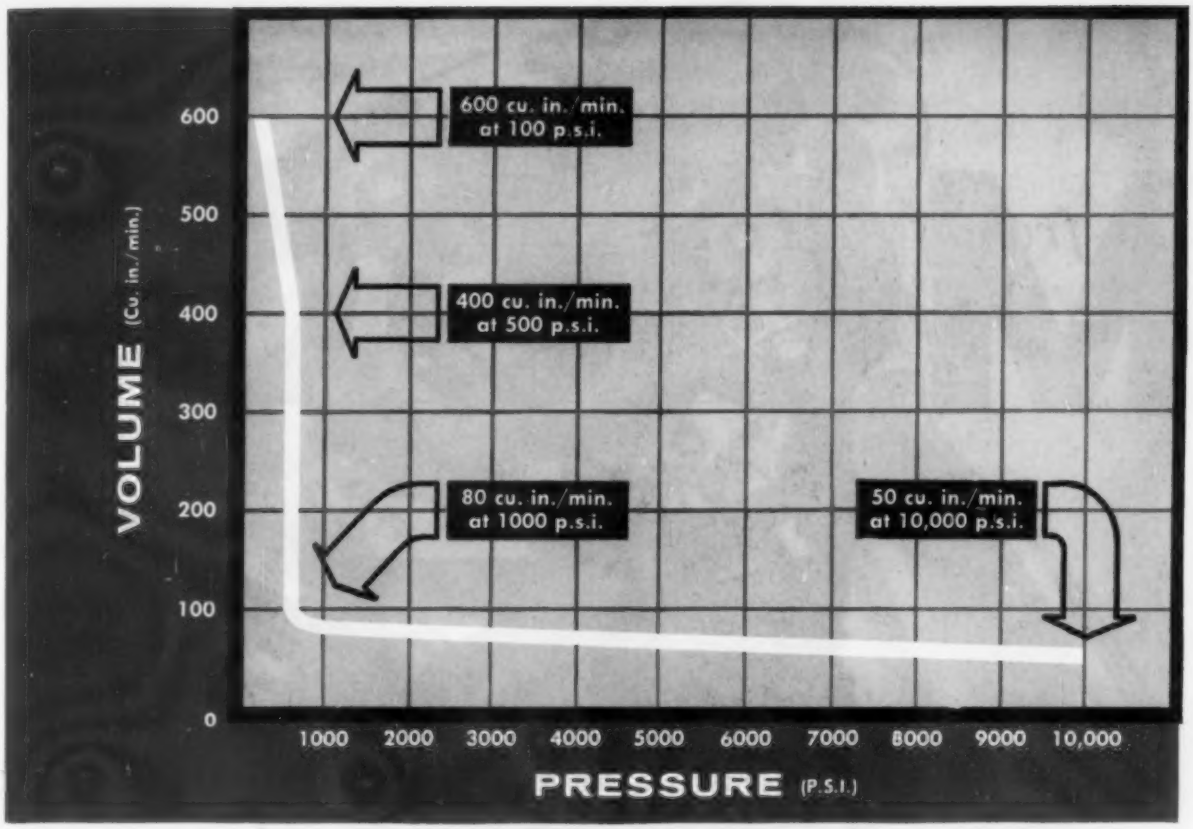
When installing O-rings in internal grooves to seal against a plunger, the deformation or permanent set in the O-ring is usually not a problem since it can be installed by "figure eighting" the ring. A rule of thumb for the amount you can stretch a Teflon O-ring without permanent deformation, is about 10%.

• **Square Shapes**—Square shapes in rubber are usually used where rings tend to spiral-twist, where low pressure sealing is difficult, or where lubrication is difficult and friction high. Square shapes are particularly well suited for O-rings of Teflon because the shape compensates for the lower resiliency of the ring. These rings are designed to fill packing grooves more than other squeeze types.

Square rings can be used in grooves made for regular O-rings. They have less movement as pressure changes from side to side on reciprocating applications. Again, a 4 to 16-rms surface finish of the sealing surface is best.

• **Wedge Seal**—A spring actuated wedge seal is shown in Figure 5. In this illustration, the circular wedge of Teflon is compressed against the shaft. The compression is accomplished by springs pushing against the inner wedge. The inner wedge slides against the face of the outer wedge forcing itself to seal against the shaft and also causing the outer wedge to expand outward against the inside of the housing and seal at that point.

This seal is used mainly for reciprocating service, but rotary and static seals use this same wedge principle. It has been used as a reciprocating rod seal at 550 F and 4000-psi pressure. □□□



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By Richard A. Freedman

O-Ring principles, selection, inspection, and installation are discussed emphasizing their leakage causes, detection, and prevention.

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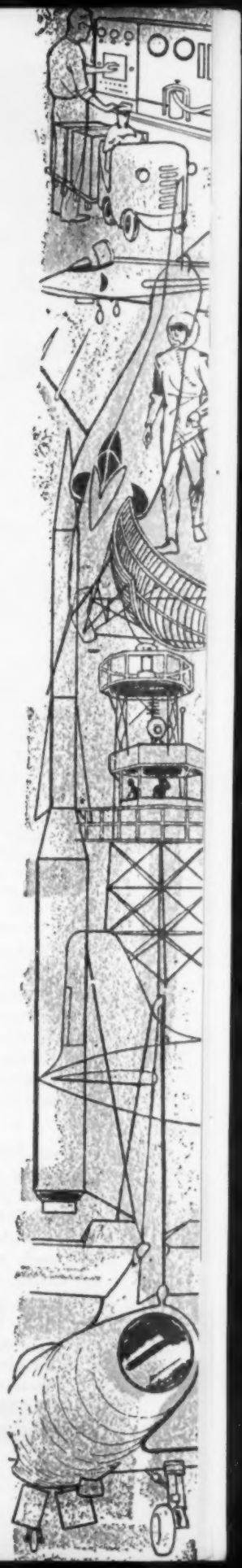


What you should know about O-RINGS for air and oil circuits

• By RICHARD A. FREEDMAN, *Senior Design Engineer, Hydraulics Group, Convair, San Diego, California*

FROM a maintenance standpoint, O-rings involve problems of hydraulic leakage and pneumatic lubrication. Maintenance inspection of O-ring seals revolves around two questions:

1. How many drops of fluid must seep past a hydraulic O-ring before they indicate an objectionable leak?
2. How much air must seep past a pneumatic O-ring before there is an indication of a damaged O-ring?

To understand the hydraulic problem of leakage and the pneumatic problem of lubrication, it is necessary to consider the special features of hydraulic and pneumatic O-rings separately. With this background, you can tell the difference between a seep and a leak.

• **How An O-Ring Works**— The O-ring fits in a rectangular groove. If the operating pressure exceeds 1500 psi, non-extrusion devices known as back-up rings are usually used on both sides of the O-ring, but sometimes only on the side farthest from the pressure.

The O-ring has an interference fit in the gland, at right angles to the direction of the operational pressure. The compression thus achieved is called squeeze.

Under higher pressures there is more scrubbing, rolling, and distortion, in addition to a tendency of the O-ring to adhere to the metal surface. Under low pressure, the friction is considerable. To prevent leakage at low temperature and pressure, more squeeze is required, because sealing efficiency drops. Reducing squeeze lowers the friction. This is offset at high pressure when the O-ring is compressed in the end of the groove.

O-rings have breakout friction and running friction. Breakout friction is caused by extrusion of the packing material into the minute pores of the mating surface or by adhesion to such surfaces. Running friction is caused by rubbing of the packing material along the mating surface. Breakout friction generally exceeds running friction.

Proper design of the groove and lubrication of the O-ring allows freedom of movement of the O-ring in its groove.

Hydraulic O-rings are kept lubricated with the hydraulic fluid in the system. Some of this fluid enters the seal.

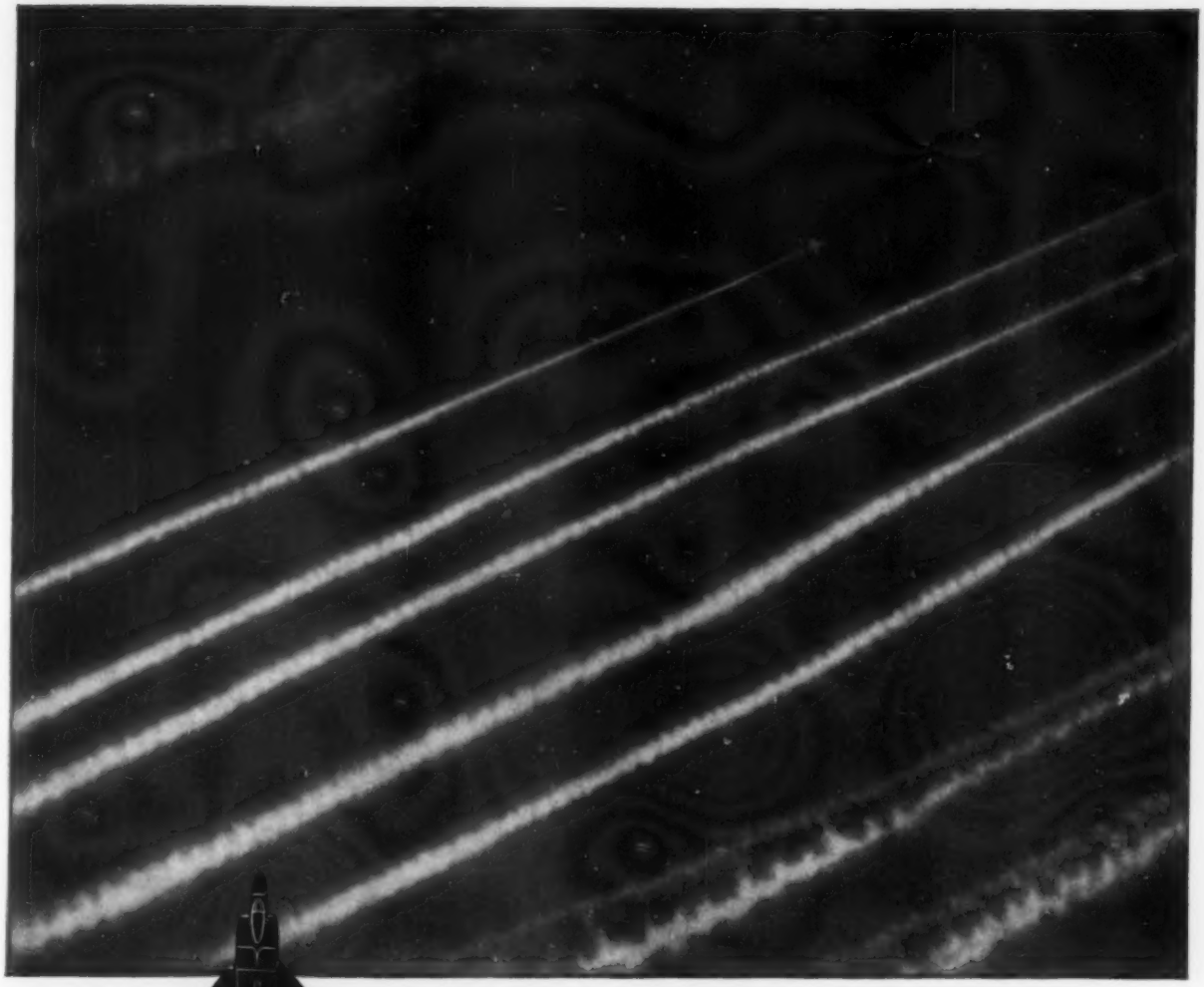
• **How much Leakage?** — Although there must be penetration of some hydraulic fluid into the groove for O-ring lubrication, the amount of fluid escaping past the O-ring must be limited.

As pressure increases and then decreases, the O-ring moves and rolls in it's groove. This movement and roll create a pumping action. The seepage resulting from this action provides lubrication of the O-ring. The faster the pressure cycles in the system, the greater is the pumping action of the O-ring, thus the operation cycle rate determines to a great extent the rate of drip from the O-ring. The maximum number of drops permitted to seep as external leakage from any one dynamic seal is one drop per 25 cycles of operation. Thus, one O-ring used for one complete cycle during an entire flight should not leak one drop, where another with an operational rate of one cycle per second may leak one drop per 25 cycles, or 144 drops per hour.

Since a single drop of hydraulic fluid measures approximately 0.05 cc, the one-cycle-per-second O-ring may drip 7.2 cc of fluid per hour without the seep being termed an objectionable leak.

Even a static seal moves as the pressure against it changes. This movement of the static seal is usually just enough to lubricate it

Continued on page 130



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without any indication of external seepage.

An O-ring will leak more in cold weather, because the rubber contracts more than the metal, thus providing less squeeze. If the temperature of the O-ring fluctuates (as when an aircraft is moved in and out of a hangar during cold weather), the leakage is still greater.

• **Oiling An Air Seal**—Pressurized air from the system dries out lubricant on the seal.

Lubrication can be provided by a felt wiper thoroughly impregnated with lubricating grease comparable to MIL-L-4343A. Pneumatic seals lubricated like this will have operated 50,000 continuous cycles without service.

• **Checking For Air Leaks**—To determine if the seepage rate is too high, a system blowdown check can be made as follows:

1. Pressurize the system to 3200 psi.
2. Disconnect the air compressor and allow 30 minutes for the system temperature to stabilize.
3. Re-pressurize the system to 3000 psi.
4. Record the pressure reading of the system and, one hour later, recheck reading for drop.
5. If the pressure has dropped more than 100 psi, the system is losing too much air. Check for leaks.

Bubble fluid may be used for locating air seeps. Such seeps may not be great enough to cause damage, but the seal can, thereafter, be watched for any increase in seepage rate.

If the pneumatic component is losing air, the O-ring and its wiper need lubrication or replacement.

• **Seal System Inspection** — Proper O-ring maintenance necessitates periodic inspection. The following must be determined:

1. Is the hydraulic seal dripping fluid damaging another component or creating a fire hazard?
2. Is the drip rate excessive?
3. Has there been any increase in the rate of drip since the last inspection? (Since an increase may indicate the beginning of trouble, the component should be carefully watched at frequent intervals.)
4. Is the drip rate normal for this type of installation?
5. Is any air escaping from the pneumatic seal? If so, is the hourly leakage rate high enough to require a close check on all seals?

If we understand the purpose of the O-ring and realize that it was never meant to be an absolute seal, there will be little trouble determining how many drops of fluid must drip from a hydraulic seal before the seep becomes an objectionable leak, or knowing how important it is to replace pneumatic system components with dry O-rings.

• **Trouble-Shooting** — Inspection of the old, damaged O-ring may indicate failure from wear, extrusion, disintegration, or excessive permanent set. Excessive extrusion may show that the old O-ring was improperly selected for its groove, that the fittings are not correctly sized, or that incorrect backup rings were installed.

A twist in the old O-ring may indicate that the groove was too wide, allowing the seal to roll. This might be because the O-ring was too thin. The groove may have been designed for an O-ring with one or two backup rings and the wrong combination installed.

Irregular wear of the old O-ring may show it was deformed by abrasion from a burr. Manufacturing defects missed at inspection may also cause failure.

If the O-ring lacks proper resilience, it may be due to high temperatures of 225°F to 300°F for which it was not designed. Usually it has a frosty appearance, takes a set, lacks resilience, and cannot withstand friction effects. Regardless of appearance it should be replaced if it has been exposed to over temperature.

MS28784 O-rings which are designed for hydraulic operation in temperature ranges from —65°F to 275°F, are being used more, although they are not used for high-pressure pneumatic systems.

Tools for removing O-rings should not be sharp, because they may mar the groove.

• **Selecting A New O-Ring**—Having determined the correct type of O-ring by checking the old one, the fittings, and the design, selection can be made from the proper O-ring chart.

Dynamic seals have a blue dot to indicate hydraulic use. Subsequent dots identify the manufacturer. Static seals are identified in hydraulic systems by a blue stripe on the outer perimeter.

To inspect a new O-ring for imperfections, stretch and roll it between your fingers and look for indentations in the form of holes, spirals, or grooves. This "new" O-ring may have been previously

... Continued on page 132

O-RING MAINTENANCE QUIZ

Q. When is a seep a leak?

A. Hydraulic leakage in excess of one drop per 25 cycles of operation constitutes a serious leak.

Q. How can O-ring installation technique best be described?

A. If the installation of O-rings could be described in one word, that word would be GENTLY. Great care must be exercised to protect the rings' smooth surfaces.

Q. What are the greatest detriments to smooth, efficient O-ring operation?

A. The worst failing of any seal is, of course, leakage. In the case of O-rings, the common causes are incorrect lubrication, excessive friction and improper design or installation.

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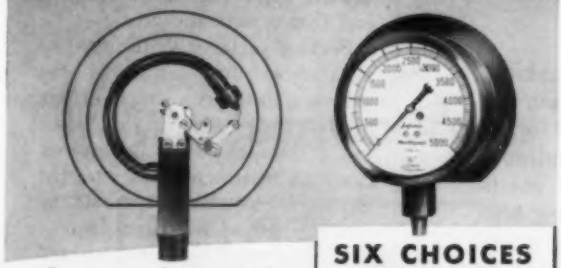

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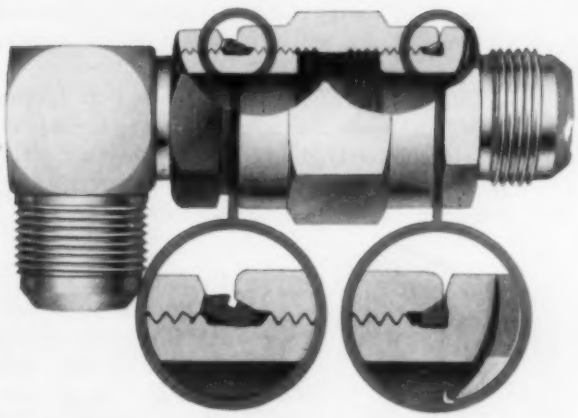

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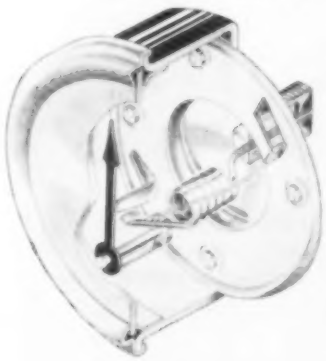

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tried on another fitting, found to be too tight, and returned to storage.

Any new O-ring which has been tried on a fitting and found to be too tight should be discarded.

• **Installation**—Avoid marring the smooth O-ring surface with fingers, tools, or fitting threads. Be careful not to pinch the O-ring between the boss and the fitting. Watch for sharp edges on the shoulder of the groove or the fitting. Sometimes running a nut on a thread will remove a burr.

For hydraulic system O-rings, clean all metal surfaces with hydraulic oil, preferably by immersion and brushing. Immerse the O-ring in oil. A small amount of petroleum may be used. Do not wipe the parts with a cloth, since this may leave lint.

For pneumatic system O-rings, clean all metal surfaces with solvent. One type has a kerosene base which leaves a light film that inhibits rust. It also leaves a good surface for adherence of a lubricating grease such as MIL-L-4343A. Coat the metal surfaces and O-ring with the grease.

Seating varies with the type of installation. Installation of the seal on a piston is a simple matter of stretching the O-ring and rolling it into place in its groove. Since no twist is allowed after the O-ring in installed, it should be straightened as it is installed.

O-rings used in glands without backup rings are usually limited to a maximum operating pressure of 1500 psi, particularly when used as dynamic seals. When used as static seals, they may, with certain design limitations, be used at high pressures without backup rings.

If a backup ring is used on only one side, it should be installed on the downstream side of the O-ring. If pressure is in alternate directions, one backup ring must be placed on each side of the O-ring. If the design calls for a leather backup ring, the smooth-grained side of the leather should be placed next to the O-ring. □□□

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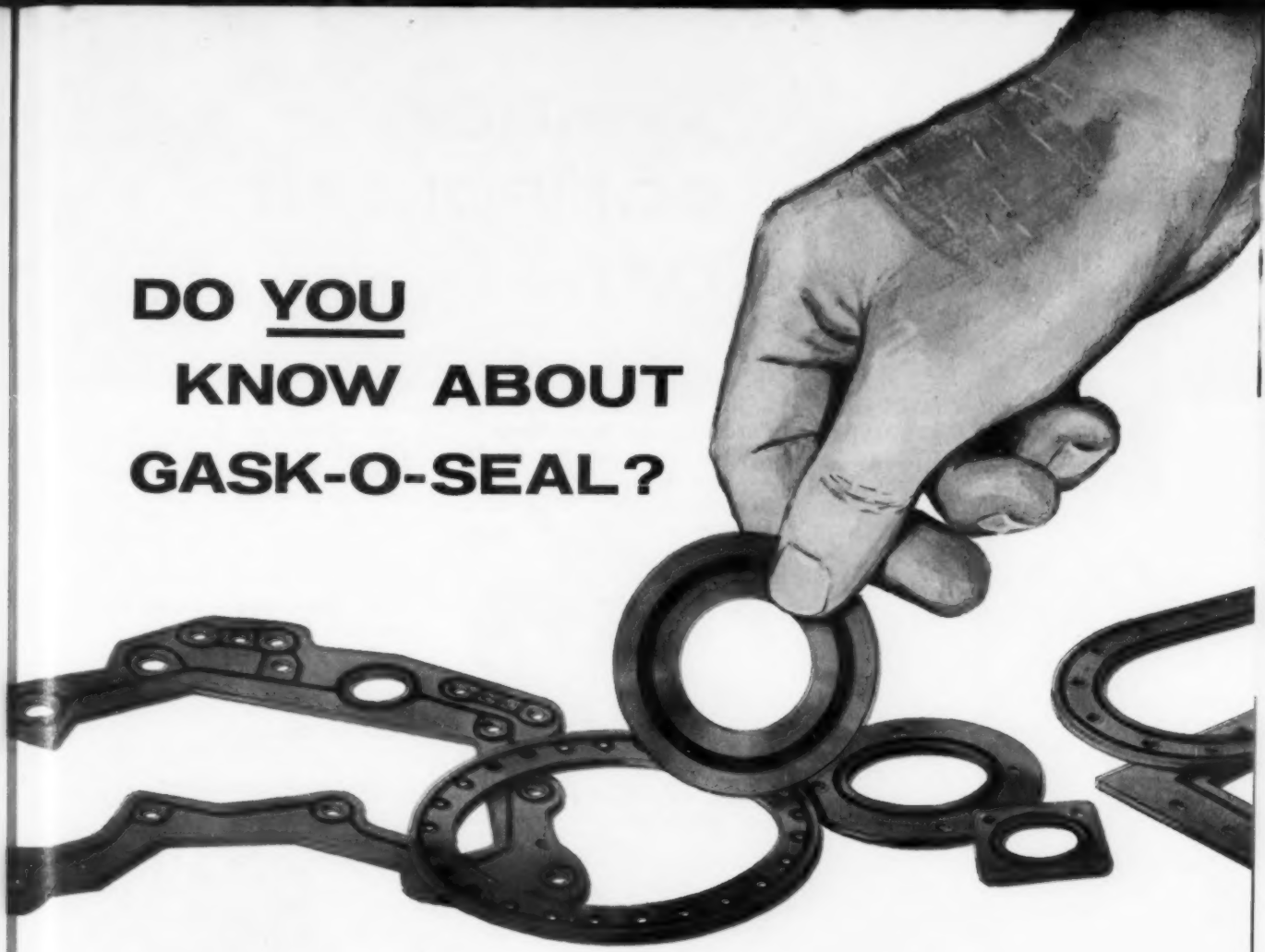
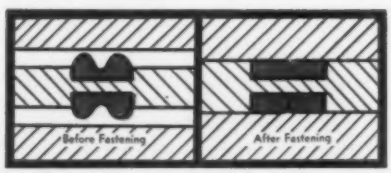


The static seal that can not blow out!



The above diagram is "typical" only. Gask-O-Seals are also made with one-side seals.

If you do not know about Gask-O-Seals look at these facts:

- Gask-O-Seals will seal practically any processable fluid . . .
- Gask-O-Seals can be re-used . . .
- Gask-O-Seals will seal at low or high pressures, vacuum or positive . . .
- Gask-O-Seals are available as standards and as specials in almost any configuration or to meet special requirements.

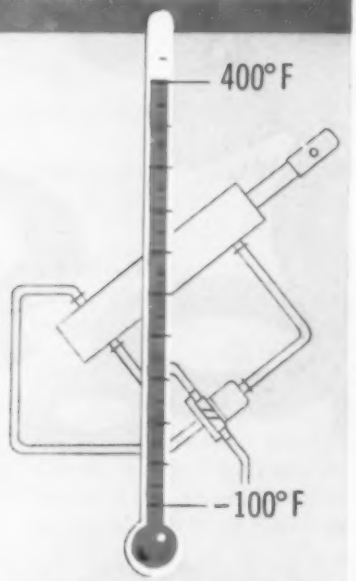
They are recommended for flanges, gear boxes, transfer cases . . . any place where truly efficient static seals are needed.

Note: A recent development of the Gask-O-Seal principle indicates effective sealing in the temperature ranges of −400° to +1000° for specific applications.

Parker SEAL COMPANY
CULVER CITY, CALIF. • CLEVELAND 12, OHIO
A DIVISION OF Parker Hannifin CORPORATION

Circle **107** on *Time-Saver Card*

Bendix
in Southern California
NEEDS HYDRAULIC DESIGNERS



One of the major programs at Bendix-Pacific is the long range development of high precision hydraulic controls for missiles and aircraft. We are seeking creative engineers familiar with high temperature requirements who are interested in pioneering the new frontiers.

Bendix-Pacific is one of the largest and best equipped sources for hydraulics in the nation. You are sincerely invited to consider joining this forward looking company where you can enjoy all the advantages of Southern California living.

Please mail the coupon or write today.

W. C. Walker, Engineering Employment Mgr.
Pacific Division, Bendix Aviation Corp.
11626 Sherman Way, North Hollywood, Calif.

I am interested in hydraulic engineering.
I am a graduate engineer with _____ degree.
I am not a graduate engineer but have _____ years experience.

Name_____

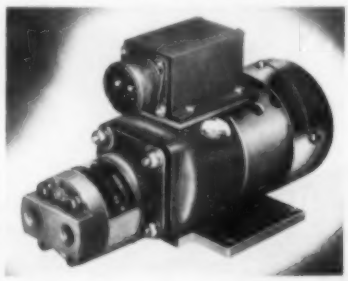
Address_____

City_____ Zone____ State_____

AVIATION COMPONENT DATA

Piston Loaded Gear Pump . . . motor driven

The pump has a 0.2 gpm capacity (minimum) at 3,000 psi outlet



with 9 psi absolute inlet at 26 volts. Life of the unit is 500 hours and is qualified per MIL-P-5954 A. Total weight is only 7.9 pounds. *–Great Lakes Mfg. Co., Cleveland.*

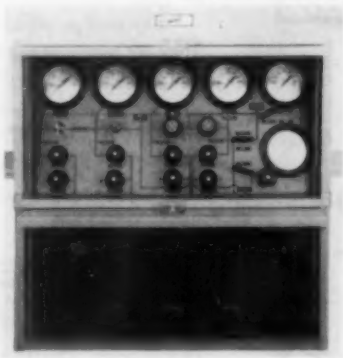
Circle **500** on Time-Saver Card

Dehydration and Valves

Dehydration, vapor indicators and metering valves are among the topic headings in this book. Performance data and drawings are included.– *Robbins Aviation Inc. Los Angeles, California.*

Circle **501** on Time-Saver Card

Console . . . regulates gas



Separate connections supply 500 to 1,000 psi and 3250 to 4500 psi gas pressure sources. Outlet pressures regulated are 0 to 40, 40 to 250, 250 to 1500, and 1500 to 3000 psi. Each line has individual relief, pressure shut off, check and vent valves. A 50 cubic inch receiver upsteam of the pressure regulator in the 0 to 40 psi outlet line compensates for line surge.– *Haskel Engineering & Supply Co., Glendale, Calif.*

Circle **502** on Time-Saver Card

Loading regulators . . . to 10,000 psi

Designed for low capacity testing (2scfm) of valves, missile and aircraft components. Operating

temperature range from –67F to 250 F. Available in bronze or stainless steel. Outlet pressure held after inlet pressure decays. *–Victor Equipment Co., San Francisco.*

Circle **503** on Time-Saver Card

Test Carts . . . in new brochure

Bulletin No. 1370 describes hydraulic test carts to simulate missile power packages for production check out. Bulletin No. 1382 describes a test console for check out of 5,000 psi hydraulic components.–*George L. Nankervis Co., Detroit.*

Circle **504** on Time-Saver Card

Continued on page 136
Circle **111** ➡

to protect a product in process, storage or transit

THERE'S A CAPLUG* THAT WILL DO THE TRICK

take your pick from over 500 sizes in a dozen different styles now in stock

* Molded of tough, flexible Polyethylene, Caplugs won't chip, break, shred or collapse. Easy to apply and a cinch to remove, they're most kind to threads and polished surfaces.

get a kit full of samples in exchange for the coupon attached

CAPLUGS DIVISION,
PROTECTIVE CLOSURES CO., INC.
2203 Elmwood Ave., Buffalo 23, N.Y.

Mail a free assortment of Caplugs, literature and prices to us, without obligation.

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J. W. WECHSELBERGER
Vice-President
RESEARCH & DEVELOPMENT

RESEARCH & DEVELOPMENT
DEPARTMENT OF
PLASTIC AND RUBBER PRODUCTS CO.

−67° for 72 hours

Design Engineers at General Controls, a Company noted for its precision products, specified Parco O-Rings for their aircraft motor-operated gate valve. **When tested at −67°F for 72 hours, the gate valve's powerful action physically sheared cylindrical ice columns . . . positive proof of its effective sealing performance under adverse operating conditions.** The dozen Parco O-Rings installed in the gate valve met all operational requirements.

The O-Rings used in any fail-safe valve must cope with other than environmental conditions. Dirt, dust, abrasion, corrosive influences, and resistance to chemical and physical change must be considered.

Fortunately, you as a user of Parco O-Rings, will have these specific O-Ring problems presolved for you by Parco's extensive Research and Development Laboratories. And a Parco Engineering Representative is always available to aid you in selecting the right Parco O-Ring for a specific purpose.

Plastic and Rubber Products Company
2100 Hyde Park Boulevard
Los Angeles 47, California

Circle **110** on Time-Saver Card

AVIATION COMPONENT DATA

Pneumatic Hose . . . for 6,000 psi

For missile pneumatic charging systems, this new Teflon hose has a burst pressure of 24,000 psi. The 678 hose has zero moisture absorption and an anti-adhesive surface. Spirally wound stainless steel wire overlaying a stainless inner braid reinforces the hose. Available in ⅜" and ½" sizes.— *Aeroquip Corp., Jackson, Mich.*

Circle **505** on Time-Saver Card

Flow Regulator . . . is externally adjustable

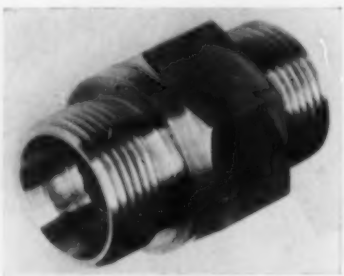
Pressures range from 5 to 6000 psi at flows from 0.5 to 32 gpm.

This regulator can be used at temperatures from —65 F to 400 F.—*Vinson Engineering & Sales Co., Van Nuys, California*

Circle **506** on Time-Saver Card

Check Valves . . . miniaturized

For both flared and flareless fittings, these small check valves are sized to fit the package defined by proposed specifications

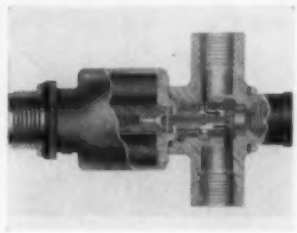


MS 24424 and MS 24423. Sizes 4 through 16, in both steel and aluminum are for Type 2 use; stainless for Type 3.—*Parker Aircraft Co., Los Angeles.*

Circle **507** on Time-Saver Card

Solenoid Valve . . . uses low current

Three-way, two position solenoid valve needs 1 amp at 14 to 30



volts dc to operate at pressures to 1,000 psi. For ⅜-inch line, it can be made for temperatures to 500 F.—*Aero Supply Co., Corry, Penna.*

Circle **508** on Time-Saver Card

28-Volt Motor . . . 2 hp at 3,000 rpm.

A new bulletin describes this d-c motor with integral gear reduction and high altitude brushes. Model D-820 data sheet outlines dimensions, and performance curves.—*Hoover Electric Co., Los Angeles, California.*

Circle **509** on Time-Saver Card

Servo Valve . . . miniaturized

A small electrohydraulic servovalve suitable for —65 F to 350 F

service uses a proven design, of the double-nozzle-flapper type. Capacities to 16 gpm at 3,000 psi. Designated Series 31 and 32.—*Moog Servocontrols, Inc., East Aurora, N.Y.*

Circle **510** on Time-Saver Card

High Pressure Gas Driers . . . in new bulletin

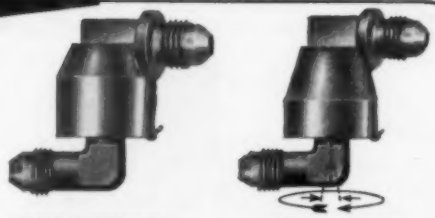
For gas drying at 1,000 to 6,000 psi, a new series of desicant dryers are described in Bulletin D-108. Performance data, selection charts and helpful information are included. *C. M. Kemp Mfg. Co., Baltimore.*

Circle **511** on Time-Saver Card

Continued on page 138

Circle **14** on Time-Saver Card

NOW AIRCRAFT TYPE **SWIVEL JOINTS**



LOW TORQUE PLANE SWIVEL JOINT— 360° rotation in a single fixed plane.

NEW SELF-ALIGNING SWIVEL JOINT— 360° rotation *plus* 15° side flexibility.

BARCO Offers Two Standard Types

Here are the newest designs in the field! SEND TODAY FOR BARCO CATALOG 269A. Since 1941 Barco Swivel Joints and special Flexible Assemblies have met the precise requirements of in-flight and other types of military equipment . . . *conforming to MIL-J-5513A and other specifications.* Barco's wide experience is yours to call upon in the development of your particular project — aircraft, missile, track vehicle or special installation — for hydraulic, pneumatic, oxygen, fuel, gas or liquid service. Barco Representatives are at your service in the specification of standard or specialized adaptations of standard designs.

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THE COMPLETE PACKING UNIT for Hydraulic or Pneumatic rods and cylinders

MON-O-PAK® CARTRIDGE

- Easily and quickly installed.
- No adjusting necessary.
- Equipped with Anti-Backlash rings.
- Includes Seal-Guard® rod wiper.
- Low friction coefficient.
- Shock and burst proof.
- Reduces initial machining cost.
- Gives longer service life.
- Cuts machine down-time.
- Easily removed for replacement.

Write for catalog and prices.

HYDRAULIC ACCESSORIES CO.
24301 Hoover Road, Warren Mich.

Circle **71** on Time-Saver Card

PULLS UP TO 28" OF VACUUM ...CONTINUOUSLY!

no messy, oil-laden discharge vapors

B&G Vacuum Pumps are *oil-less* units that will pull up to a 28" vacuum—not intermittently but *continuously!*

These pumps are constructed with carbon-graphite piston rings and skirts—bearings are grease packed and *lubricated for life.* This oil-less operation not only means freedom from expensive maintenance and lubrication problems but does away with messy, oil-laden discharge vapors.

B&G Vacuum Pumps are extremely compact—can be easily integrated with equipment and machinery designs. Available as bare dry Vacuum Pumps or dry motor Vacuum Pumps, powered by B&G-built, quiet, vibration-free motors, displacements to 6.57 CFM at 1725 RPM. Write for Bulletin GO-259.

Two B&G Vacuum Pumps are integral components of this vacuum lifter which handles 2,000 lb. metal sheets.

FULL LINE OF OIL-LESS AIR COMPRESSORS

Quiet, smooth-running, long-lived B&G Compressors deliver clean, cool, dry, oil-free air. 58 models—from portable, lightweight 35 lb. single stage to 175 lb. two stage motor compressor units—bare compressors—tankless and air tank motor compressor outfits—A.S.M.E. or non-code tanks.

Oil-less VACUUM PUMPS

BELL & GOSSETT COMPANY
Dept. FU-66, Morton Grove, Illinois

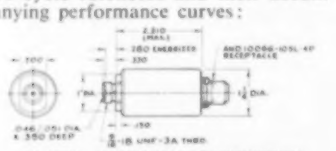
Circle **153** on Time-Saver Card

SPECIAL REPORT ON 400 CYCLE SOLENOIDS:

400 Cycle AC Solenoid With Internal Rectifiers Developed by PSP

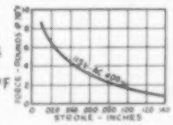
AC Solenoids using internal rectifiers, the most efficient approach to the 400 cycle problem, are now being manufactured by PSP Engineering Company, Maywood, California. Rectified 400 cycle solenoids gain the efficiency of an AC transmission system, yet retain the magnetic efficiency of DC solenoids, are quiet in operation, and lend themselves to pressurization better than AC types.

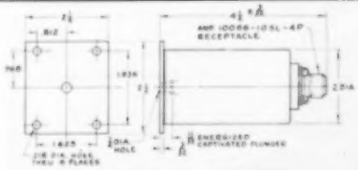
The PSP 400 cycle solenoids are manufactured in general accordance with MIL-S-4040C and meet the environmental requirements of MIL-E-5272B and MIL-E-5400C. Following are general specifications on two types of PSP 400 cycle solenoids and their accompanying performance curves:



AC PULL, SINGLE COIL CONSTRUCTION

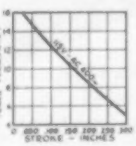
PART NO.	13SD769-1
VOLTAGE RANGE:	112 to 118 VAC. 400 cycle continuous duty
CURRENT DRAIN:	0.1 amp @ 115 VAC @ 78°F
TEMP. RANGE:	−65°F to +250°F
WEIGHT:	Unit 7.8 oz Plunger 0.34 oz





AC PUSH, TWO COIL CONSTRUCTION

PART NO.	20SD820-1
VOLTAGE RANGE:	98 to 115 VAC 400 cycle continuous duty
CURRENT DRAIN:	0.9 amp actuating @ 115 VAC @ 78°F 0.09 amp holding @ 115 VAC @ 78°F
TEMP. RANGE:	−65°F to +125°F
WEIGHT:	Unit 28 oz Plunger 2.0 oz



Information on PSP solenoids, as well as complete information on synchro components and step-servo motors manufactured by our company, is available when requested on company letterhead.

PSP engineering company

SOLENOIDS

DIVISION OF
IMC MAGNETICS CORP., N.Y.
6060 Walker Avenue, Maywood, California
LUdlow 3-4785
Representatives in principal cities

Circle **112** *on Time-Saver Card*

AVIATION COMPONENT DATA

Disconnect Coupling . . . for missiles

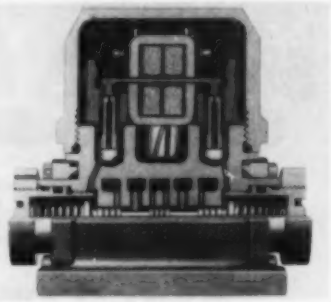
For severe impulse duty per MIL-C-25427 coupling is rated at 4,000 psi. Otherwise, 6,000 psi is normal rating. Has a full 360° grip

on the mating part for maximum locking. Can withstand high pressure and shock loads.—*On Mark Couplings, Los Angeles.*

Circle **512** *on Time-Saver Card*

Servo Valve . . . has shrouded nozzle

This design retains the superior response and temperature stability advantages of the wet coil configurations while eliminating their

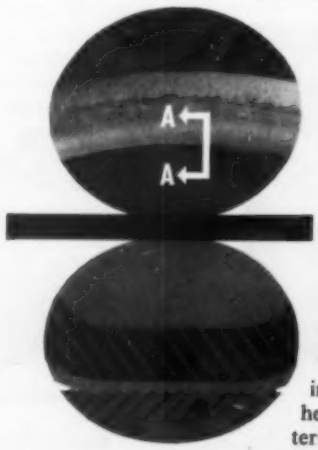


possible contamination problems by channeling the oil away from the torque motor. High contamination resistance, better response result from two-air gap torque increase. — *Bendix-Pacific Div., North Hollywood, Calif.*

Circle **513** *on Time-Saver Card*

Couplings . . . in new booklet

Fast, economical means of quick coupling hoses, pipes and tubing for fluid handling is explained in this brochure. Photographs and



TOP: Tool marks visible in TEFLON coating, magnified 12X.

BOTTOM: Section A-A TEFLON . . . conforms to irregularities in machined surface.

PERFECT SEAL . . . Teflon* coating mates United's metallic O-ring to surface!

Teflon, permanently bonded to a United metallic O-ring, conforms to normal tool marks which it contacts in a machined seat. This remarkable, non-porous, pliable coating compresses into these irregularities to help form a perfect seal. Spring steel characteristics of the O-ring metal are retained, and the surface conformability of a rubber-like compound is added. Finish is completely non-corrosive and resistant to chemical action. Tests with gases and liquids, at high and low pressures, prove absolute sealing action. United also makes hollow tube; pressure-filled; and patented† self-energized metallic O-rings; and wire and brazing O-rings to practically any required dimensions. Write for information (on your letterhead please).

*TEFLON IS THE REGISTERED TRADEMARK FOR DUPONT TETRAFLUOROETHYLENE RESINS. † PATENTS 2,809,269; 2,837,360

UNITED METALLIC "O" RING CORP.
Dayton, Ohio • Box 1035
Division of United Aircraft Products, Inc.

Circle **137** *on Time-Saver Card*

dimensions of fittings are included. *–Roto-Lock Couplings, Inc., South Gate, Calif.*

Circle **514** on Time-Saver Card

Differential Pressure Indicator . . . from 5 to 5,000 psi

A red button is raised to view when the differential pressure in a system exceeds a stated value. Can be used to detect component clogging and pressure drop in a system. Weighs 0.27 lbs. For −65 F to 275 F service.–*Aircraft Porous Media, Inc., Glen Cove, N.Y.*

Circle **515** on Time-Saver Card

New Seal . . . is metal-to-metal

The line contact principle is employed in this seal. Not affected by extremes in temperatures, it may be used in shut off and check valves with no synthetic seal aids. *–Hydraulic Mechanisms, Inc., Brooklyn.*

Circle **516** on Time-Saver Card

Ball Valve . . . with venturi flow

Metal-to-metal seats and small size are main features of this new

ball valve. For use in corrosive fluids, the valve has no elastomeric seals. Venturi flow permits small ball. Hand, solenoid and motor-operated versions are available.–*Waldorf Instrument Co., Huntington Station, N.Y.*

Circle **517** on Time-Saver Card

Servo Actuators . . . in airborne hydraulics

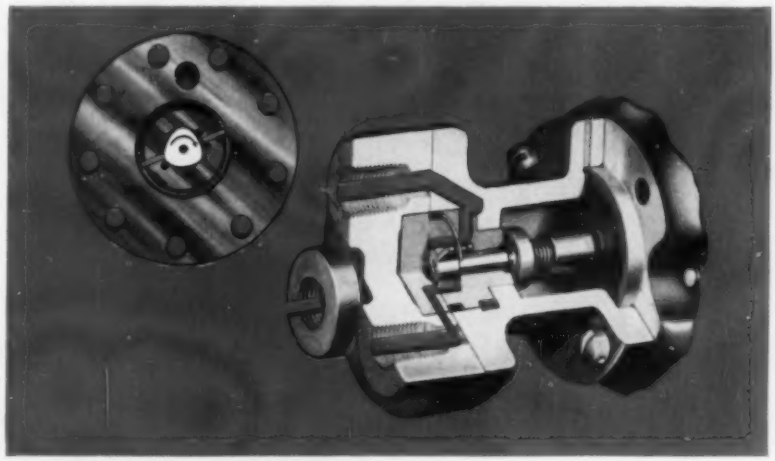
A line of hydraulic servo actuators for high performance aircraft features excellent frequency response, long shelf life, and low internal and external leakage. Full descriptive literature available.

Continued on page 140

YESTERDAY'S PIONEER . . . TODAY'S LEADER

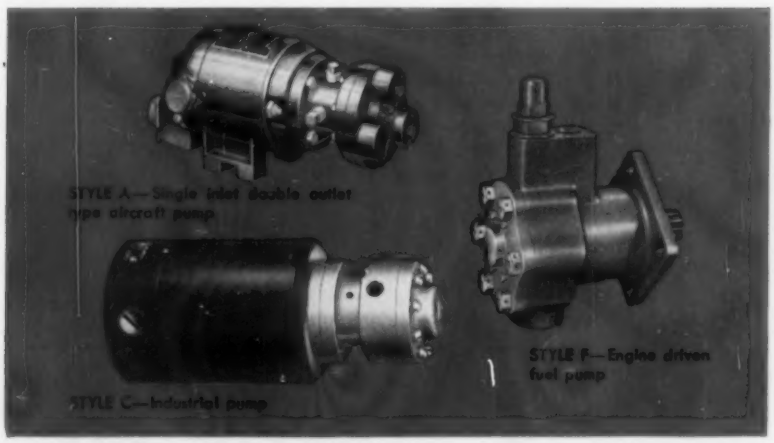
WELDON / **FLUID METERING PUMPS**

Positive Displacement Rotor Type. For Industrial Applications, Aircraft Anti-Icing and Aircraft Fuel.



IT'S SO SIMPLE!

The rotation of the rotor draws the fluid in through two passages, filling the cavities formed by the three lobes of the rotor. This fluid is sealed within these small cavities until it is forced through the two outlet holes by the floating blades. The flow may be kept uniformly divided through two outlet ports, or may be combined internally for passage through a single port.



COMPACT • LIGHT WEIGHT

Send for Weldon Manual and Catalog with detailed specifications and installation drawings, covering the full range of Weldon pumps in various capacities. Specify your requirements.

50 YEARS OF LEADERSHIP 1918—1958

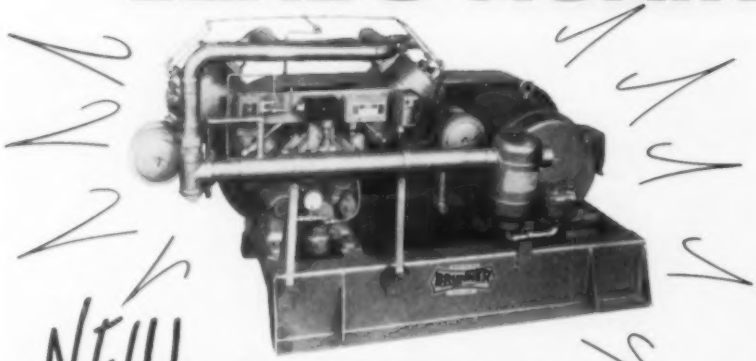
THE WELDON TOOL COMPANY

3000 WOODHILL ROAD . . . CLEVELAND 4, OHIO

Circle **146** on Time-Saver Card

BRUNNER
SINCE 1906

LEADS AGAIN



NEW **WATER COOLED AIR COMPRESSOR LINE**

Since 1906, Brunner has lead with the latest in air compressors. Now the WJ and WK (10 thru 30 HP) water cooled line joins the famous family of Brunner compressors from ¼ thru 50 HP.

6 good reasons why Brunner is preferred

BRUNNER Air Compressors:

- Are outstandingly dependable
- Provide oil and moisture free air
- Offer single or 2 stage equipment in all sizes
- Supply complete air or water cooled aftercooler assemblies with all fittings from one dependable source for all compressor sizes
- Provide "entire system" duplex units that are "operation readied" to connect to piping and wiring facilities
- Air conditioning and heating experience of Dunham-Bush engineers enables them to professionally assist in layout for dependable control systems.

ALSO WATER COOLED AFTERCOOLERS AND OTHER ACCESSORIES BY heat-x A DUNHAM-BUSH SUBSIDIARY

REQUEST:

- Bulletin #763 for water cooled specifications
- Catalog #36 for ½ through 20 H.P. data
- Catalog #37 for 25-30-40-50 H.P. industrial information

BRUNNER DIVISION
DUNHAM-BUSH, INC.
DEPT. AH. WEST HARTFORD 10, CONNECTICUT

Circle **41** on Time-Saver Card

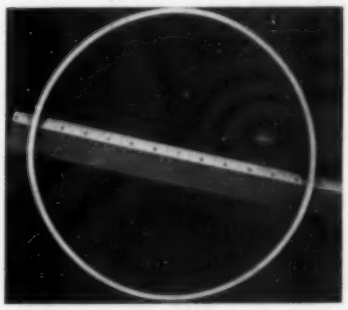
AVIATION COMPONENT DATA

Model numbers 3031, 3032, 3043 and 3048 are described in these bulletins. – *Lear, Grand Rapids, Mich.*

Circle **518** on Time-Saver Card

Ring Seals . . . non-sticking

About 12 inches OD is the size of this new Teflon flat ring seal for reducing reservoir piston friction. Good for 3,000 psi service to 275 F, ring meets MIL-H-5606 fluid requirements.–*Tri-Point Plastics, Inc., Albertson, Long Island, N.Y.*

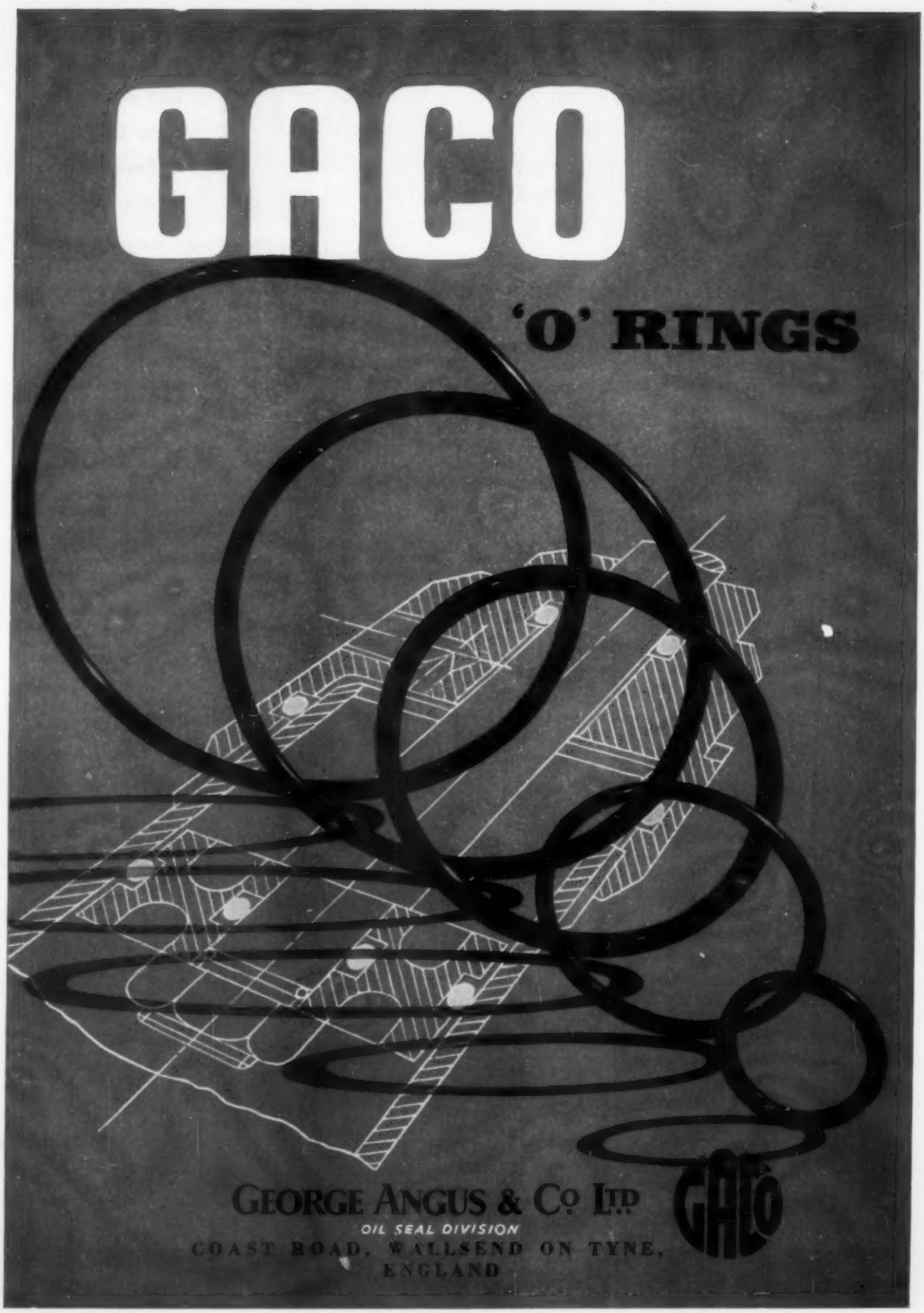


Circle **519** on Time-Saver Card

Filtration Cart . . . for 2 to 5 microns

A 55-gallon drum fits into the closed loop portable device. External circuits may be filtered simultaneously using hose fittings on the front of the stand. A one hp motor drives the circulating pump. Typical application is for filtering fluid prior to missile use.–*George L. Nankervis Co, Detroit, Mich.*

Circle **520** on Time-Saver Card


GACO
'O' RINGS
GEORGE ANGUS & Co LTD
OIL SEAL DIVISION
COAST ROAD, WALLSEND ON TYNE,
ENGLAND
GALO

AVIATION NEWS

from the fluid power field

John W. Meier, development engineer at **Hamilton Standard division of United Aircraft Corp.,** has been named to head

Meier

the company's hydraulic pump department. He joined the company in 1946 and has a background in the auxiliary power and accessory development field.

Saul Wills was appointed Airline Equipment assistant chief engineer and **Lyman A. Bullard, Jr.** named manager, Hydraulic Valve and Component Sales of the **Products Division of Greer Hydraulics Inc.** Wills has developed aircraft engine test equipment. Bullard was formerly with several aircraft organizations prior to joining Greer.

North American Aviation Inc. has created a new subsidiary, **Navan Products, Inc.,** for the purpose of marketing inventions. The philosophy of marketing inventions is, as Navan's general manager **Pat Bales** says, "It takes more to sell an idea than to have it." Financing, manufacturing and sales functions will permit more inventions to reach the market.

Three new sales engineers for the **Weatherhead Corporation's Aviation and Missile Group** have been announced. **Jack R. Ransom** will serve the State of Washington; **Richard R. Prothero,** Los Angeles area and the states of Colorado, New Mexico, Arizona and Utah; and **Mike Jenner,** Glendale and San Diego areas.

A new design, engineering and manufacturing division has been established by **Hydromatics Inc.,** in Canoga Park, California. The firm, which doubled its New Jersey facilities in March, manufactures Flo•Ball valves for airborne and ground support equipment. The new division will handle the increasing West Coast demand.

Donald A. Sutherland was elected president and member of the board of directors of **United Aircraft Products, Inc.,** Day-

Sutherland

ton, Ohio. He has been active in the manufacturing and marketing of electronic, hydraulic and refrigeration components and systems for the defense industries. **Edward L. Ladd,** the previous president, announced his resignation at a recent meeting of the board of directors.

ANNOUNCING . . .

The Birth of a New Era in Small Air Control Valves

by: WILLIAM CARLS, President, Numatics, Inc.

The last five years have seen air controls expand into countless operations where automation was once considered impossible or uneconomical. Most of these operations involve cylinders of 3¼" bore or smaller.

In these applications both the physical size and the cost of the valve are vitally important, and the wasteful practice of overvalving, using a valve of considerably greater capacity than needed, cannot be tolerated. So, more and more, these systems are being *engineered* rather than being just built.

Engineers, however, have been handicapped by the lack of well-engineered *small* valves. Up to now, small valves have gained smallness by sacrificing adequate wiring space, sub-plate and manifold mountings, manual operators, and compliance with JIC Standards. In many cases the all-important double solenoid momentary contact action simply was not available. And too often basic valving action was not heavy duty and wouldn't stand up under multi-million cycle demands.

Two years ago Numatics started development of a family of small 4-way valves for this field. Objective: to produce a well-integrated group of compact valves which would offer the heavy duty ruggedness of our famous patented lapped spool-floating sleeve action in a variety of housings, mountings, and options to cover the entire field, from a basic valve at a rock-bottom price, to a manifold assembly with all the features required by JIC Standards.

The result of two years of intense work is our new "SA JUNIOR" Series . . . a ¼" valve with capacity to operate a 3¼" bore cylinder at a piston speed of one foot per second, capable of doing about 60% of all valving jobs in the average plant, yet so small physically, and so modestly priced that it might well cut your air valve costs by 40%!

Our new catalog SAJ-59 tells the complete story of SA JUNIOR and a copy is yours for the asking. Just send the coupon below.

numatics, inc.

HIGHLAND, MICHIGAN

Gentlemen: Please rush my copy of your new SA JUNIOR Series Catalog.

Name & Title_____

Company_____

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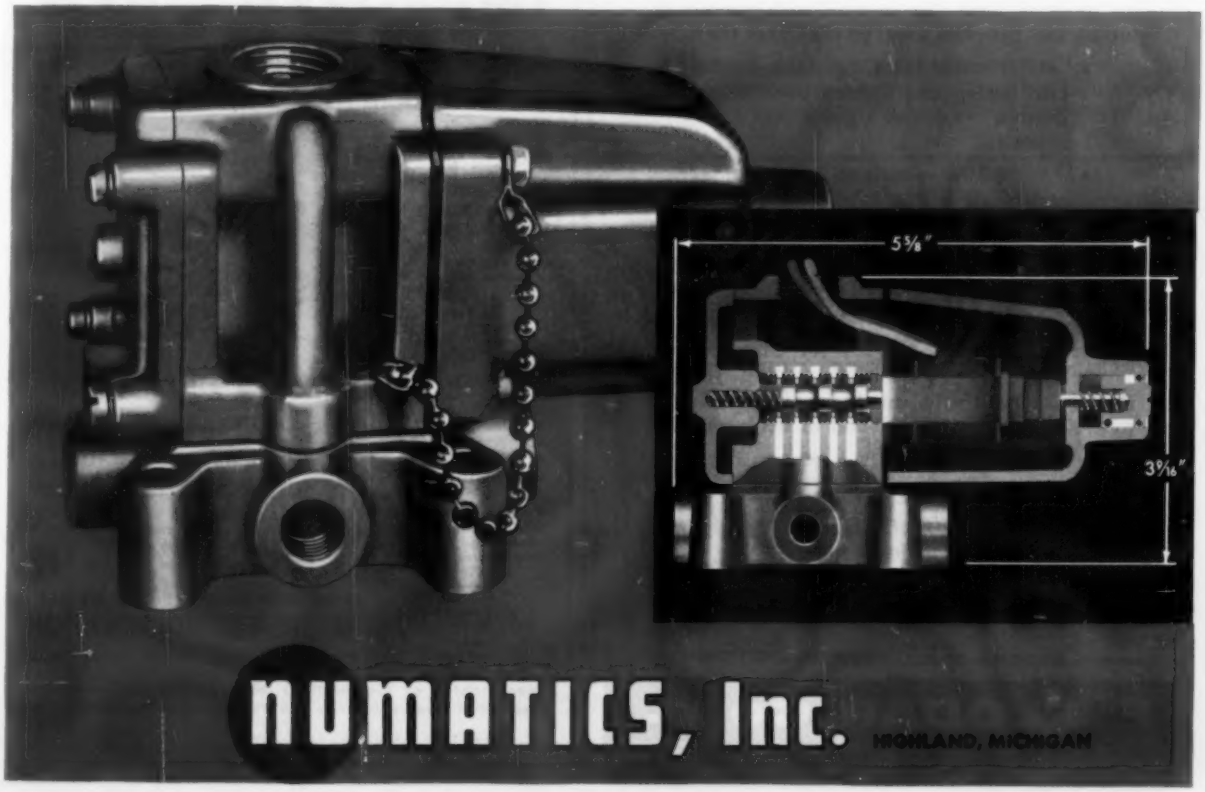
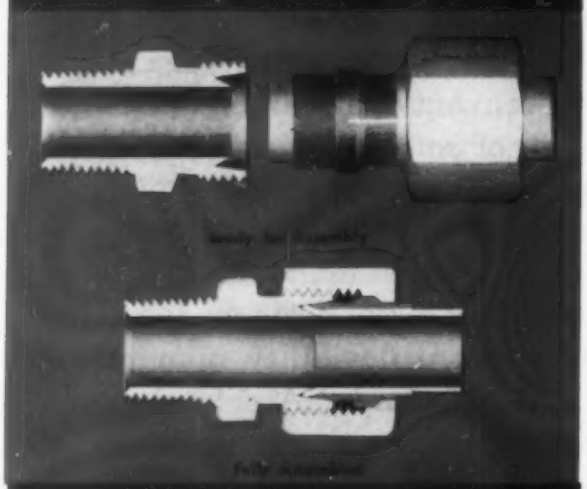
City_____ Zone____ State_____

INTRODUCING . . . SA JUNIOR

Numatics' new family of SMALL, heavy duty air valves and manifolds . . . so small the valve nestles in the palm of your hand . . . yet so powerful that it can handle 60% of *all* air jobs in the average plant . . . and at a *fraction* of the cost of conventional valving! The SA JUNIOR Series is a *complete* system of *small* valving . . . single solenoid and double solenoid momentary contact (detented) actions . . . a variety of models and options to suit any installation need . . . three different sub-plates, four styles of low-cost manifolds . . . three types of manual operators, optional quick-disconnects on the solenoid leads. SA JUNIOR truly gives you a flexibility unmatched anywhere in the air valve field! JIC Standards? Absolutely . . . with a novel new "Solenoid Capsule" construction which for the *first* time eliminates the plague of loose parts when the solenoid cover is removed. Two years in development, SA JUNIOR uses Numatics' famous patented lapped spool-floating sleeve valving action . . . the toughest, most trouble-free action ever developed. Guaranteed to give you years of maintenance-free money-saving service. For details call your Numatics representative. We'll be happy to supply his name and phone number.



Get the advantages of both FLARE and NO-FLARE Fittings with . .



FLODAR'S Self-Flare Tube Fittings

The Efficiency Of A Flare Fitting — Can be used on thin wall tubing — provides a seal on the ID of the tube.

The Easy Installation Of A No-Flare Fitting — no time consuming flaring operation — no flaring tools required. Can be used with heavy-wall tubing and, provides a seal on the OD of the tube.

- Easy Assembly — Simply insert tube into fitting and tighten nut. "Rock Bottom" stop and signals that joint is sealed.
- Double Seal — seals on both outside and inside of the tube.
- Lower Cost — FLODAR'S Self-Flare fittings cost less to buy and install.

Tube shearing and work hardening are eliminated . . . FLODAR Self-Flaring fittings can be reassembled time after time without fear of leakage or damage to tube and fitting.

Priced competitively, this fitting is available in tube sizes from ⅛" to 2" and in steel, stainless, brass and aluminum.

J.I.C. APPROVED

Send for a copy of FLODAR'S tube and pipe fitting catalog.

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Circle **67** *on Time-Saver Card*

lightest weight/easiest installation/silent no hum operation

NEW HOKE

lowest temperature rise and power consumption

SOLENOID

stainless steel plunger design / silver ac shading coil

VALVES

smallest size / packless construction / operates any position

HOKE

Complete specifications, ordering information, etc., are included in bulletin No. SV-559. Send for your copy.

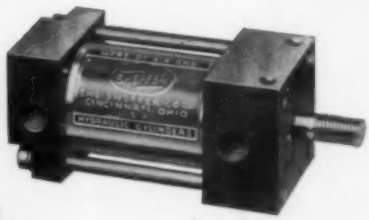
Fluid Control Specialists

HOKE INCORPORATED, 87 PIERMONT RD., CRESSKILL, N. J.

IMPROVED...NEW

UNIVERSAL, CLEVIS or PIVOT MOUNT 1-1/8" CLAMP TYPE AIR CYLINDERS!

CLA SERIES Double Acting and Spring Return



INEXPENSIVE ANSWER to TOOLING and AUTOMATION!

- **COMPACT**—only 1½ inches square.
- **VERY SHORT** overall length.
- **MOUNTS** front or rear flange, side, clevis or pivot.
- **TIE ROD** construction.
- **HEADS** machined from aluminum bar stock. Tubes, mirror smooth brass.
- **PISTON ROD**—high tensile steel, chrome plated.
- 150 psi AIR; 250 psi hydraulic
- **ADEQUATE** safety factor.
- **IMMEDIATE** delivery on 1", 2" and 3" stroke. Fractional or longer strokes available on short notice.

PNEUMATICS SHEFFER HYDRAULICS

Write NOW for NEW Bulletin No. 458

THE SHEFFER CORPORATION

Cincinnati 15, Ohio • Phone: VAlley 1-0320

Manufacturers of the Industry's most complete line of Air and Hydraulic Cylinders, Boosters and Hand Operated Hydraulic Pumps.

SOLD BY LEADING DISTRIBUTORS NATIONWIDE

See Phone Book Yellow Pages

Circle **124** *on Time-Saver Card*

Fine control with three air pressures

• By WILLIAM BURT, *Superintendent, Clair Mfg. Co., Olean, New York*

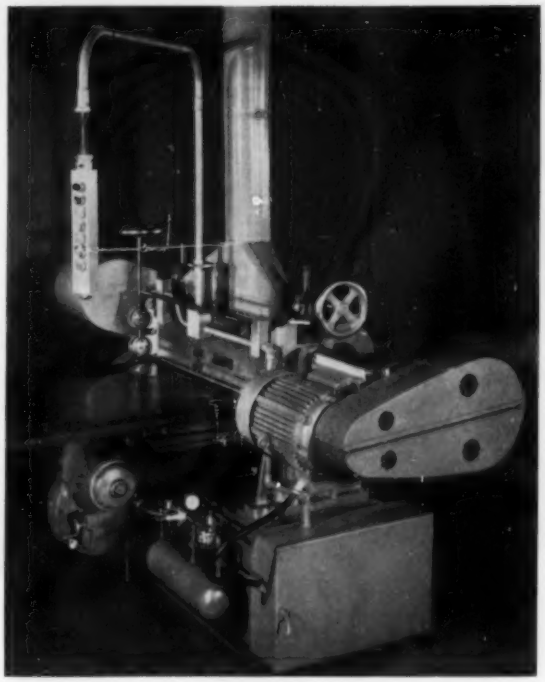
A FORMICA strip roughed up and then repolished gives the appearance of natural wood. The roughing and polishing must be done at many different feeds, speeds, and pressures. Clair Manufacturing designed this air controlled surface finishing machine that allows any one of its air cylinders to operate at a pressure setting independent of the other cylinders.

Air cylinders handle three operations: they oscillate the work roll back and forth, they maintain constant tension in the drive chain, and they control the force of the work roll against the sheet. Each cylinder has its own pressure regulator.

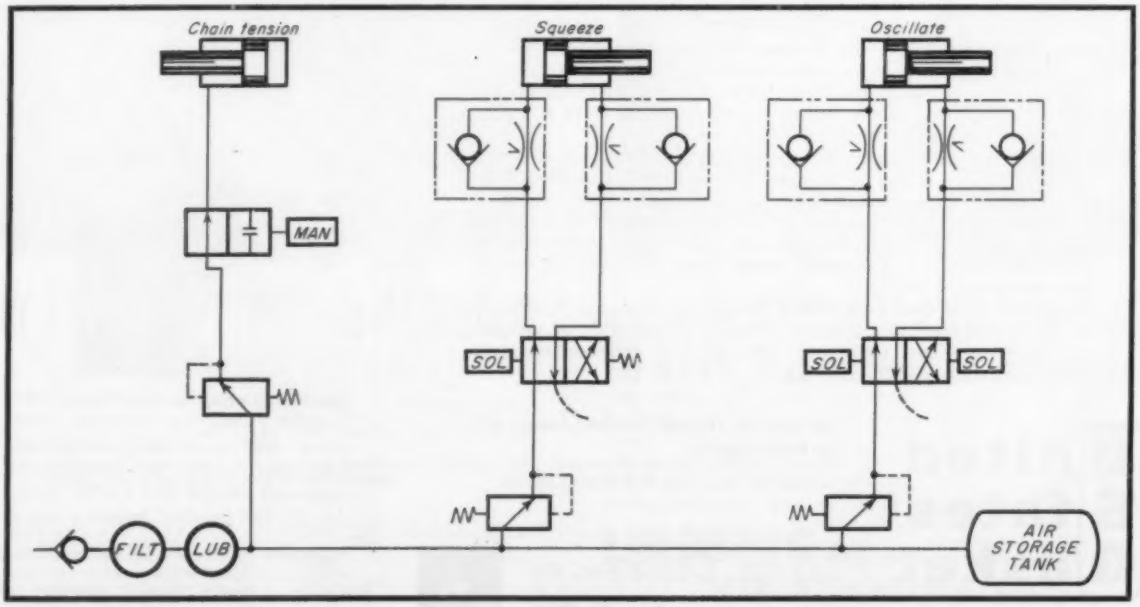
The chain tension cylinder connects to an idler sprocket through a linkage. It is a single-acting cylinder and maintains tension with air directed to the rod end. Its air regulator is self-bleeding. This allows pressure to the cylinder to be decreased without first bleeding off the higher pressure. It also keeps a uniform force on the idler sprocket as the work roll moves up and down.

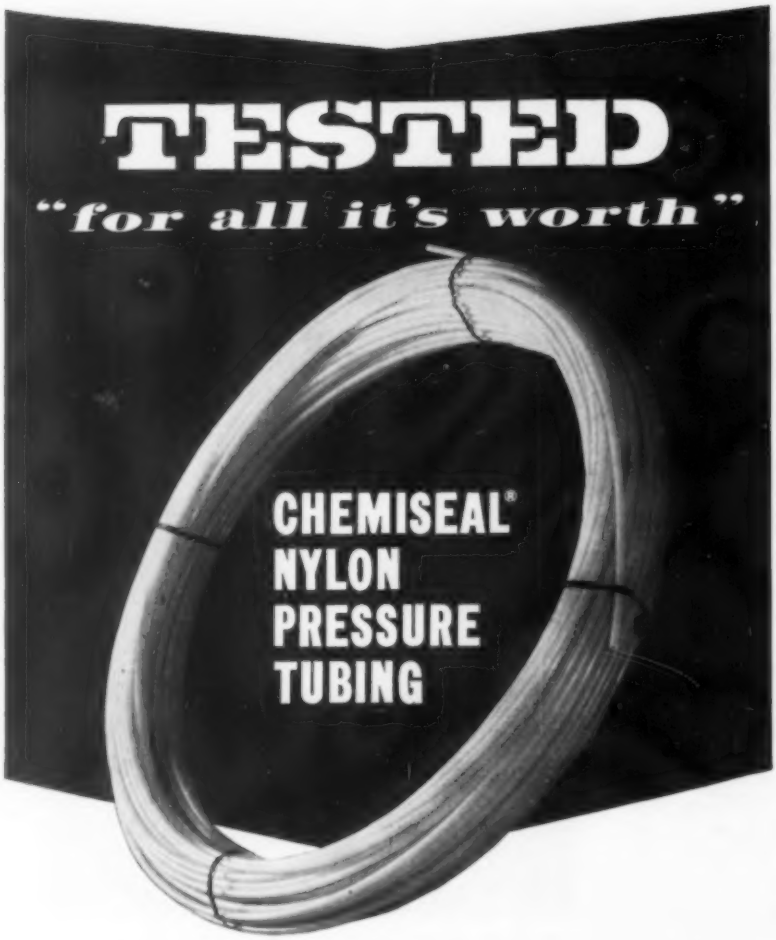
An air storage bottle keeps a supply of compressed air at the machine. This reserve air cushions the cylinder operation and assures that enough air is available in the event that all three cylinders are actuated at one time.

The squeeze and oscillating cylinders are double-acting and controlled by 2-position, 4-way valves. The valves are arranged so that the cylinders will fail safe. If electrical power to the machine is interrupted, the squeeze cylinder retracts and the oscillating cylinder completes its stroke and stops. □□□



SEPARATE, SELF-BLEEDING REGULATORS for each cylinder give complete circuit flexibility. Flow control valves govern speed of squeeze and oscillating cylinders.





TO GUARANTEE YOU best performance possible, Chemiseal Nylon Pressure Tubing is subjected to severe tests before leaving the factory. For example:

ANVIL IMPACT TEST. This test simulates the mechanical abuse that may accidentally occur in service. Chemiseal Nylon Pressure Tubing is placed on a flat steel anvil. A 16-pound hammer with a striking head of 6″ drops freely onto the tubing from a height of 24″.

ROLL BEND TEST. This test assures freedom from defects which cause flex fatigue. Tubing is passed around and between two grooved rollers to form an "S" shape. Space between rollers is twice the diameter of the tubing. Tubing is then moved back and forth at a rate of at least 125 f.p.m.

OTHER TESTS, TOO, SHOW the superior features of Chemiseal Nylon Pressure Tubing. It can be bent into any position . . . unaffected by lubricants, alkalies, acids, solvents . . . serviceable from −60°F to +180°F (can be heat stabilized for 300°F). Chemiseal Nylon Pressure Tubing is available for 1000 and 2500 p.s.i., conforming to J.I.C. specifications. Diameters range from ⅛″ O.D. to largest size commercially made.

FIND OUT HOW YOU CAN APPLY Chemiseal Pressure Tubing to hydraulic and pneumatic systems, pressure lubrication lines, vacuum system connections. Call your local Garlock representative, or write for Catalog NPT.

United States Gasket Plastics Division of **GARLOCK**

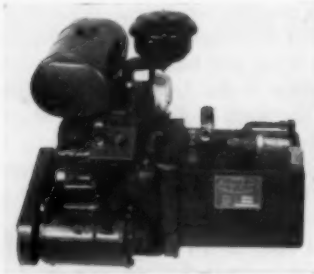
THE GARLOCK PACKING COMPANY, Palmyra, N. Y.
For Prompt Service, contact one of our 26 sales offices and warehouses throughout the U.S. and Canada.

Circle **52** *on Time-Saver Card*

NEW PRODUCTS

ENGINE DRIVEN POWER PACKAGE
. . . to 3000 psi

Features: Unit construction. Pump is submerged to dissipate heat. Cast aluminum reservoir for extra dissipation. Engine fan helps cool reservoir.



Specifications: Sizes 2 to 15 hp for pressures to 3000. Pump capacities from 0.5 to 40 gpm. Reservoir capacity from 1½ to 13 gals.

Spencer Hydraulics, Inc.
Racine, Wis.

Circle **314** *on Time-Saver Card*

AIR CYLINDER
. . . has spring return

Designation: Minimatic Hollow Shaft

Features: For automated manufacturing circuitry, semi-automatic work positions, and new end products.

Specifications: In numerous stroke lengths. Can be supplied from stock only with stud mountings, but may easily be clamp-block mounted. Model 3SS has ⅜″ bore; Model 9SS has 9/16″ bore.

Clippard Instrument Laboratory, Inc.
Cincinnati, Ohio

Circle **315** *on Time-Saver Card*

Continued on page 148

Circle **26** on Time-Saver Card

Standard For Industry

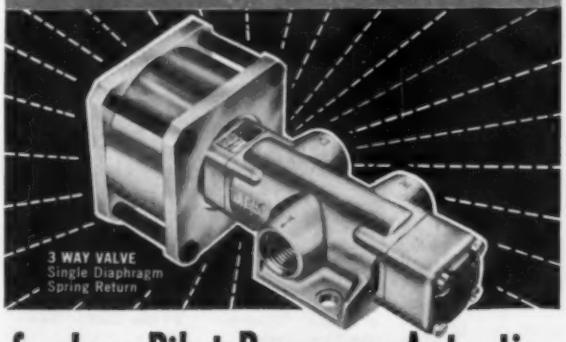
CENTURY Liquid Level SIGHT GAGES

- **Easiest Possible Installation on any wall thickness**
- **Large Face for Better Visibility— 7″ Overall**
- **Can be used with non-inflammable oil**
- **Leak-Proof — No Dripping**
- **For Better Service at Lower Costs, Start Using Century Gages Today**
- **Available Immediately — from STOCK**

Send for new catalog containing dimensional information on hydraulic reservoirs and complete line of power unit accessories.

CENTURY HYDRAULICS
Division of CENTURY-DETROIT
7701 LYNDON AVE. • DETROIT 38, MICH.
Telephone: Diamond 1-3797

VERSA Diaphragm Actuated Valves



for Low Pilot Pressure Actuation

Versa Diaphragm Valves can be actuated by pilot (or signal) pressures as low as 5 PSI on double diaphragm types and as low as 10 PSI on standard spring return models.

Versa Diaphragm Valves are available with side port bodies or for manifold mounting, and in sizes from 1/8″ thru 1″ NPT in 2-, 3-, 4-, and 5-way types, and for pressures from partial vacuum to 500 PSIG.

All Versa Valves are triple pressure and functionally tested under water for guaranteed leakproofness.

VERSA

VERSA PRODUCTS COMPANY INC.
248-A SCHOLES STREET
BROOKLYN 6, N.Y.

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Circle **138** on Time-Saver Card

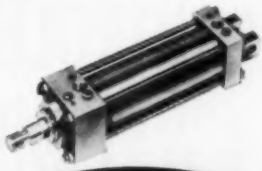
WHO'S SMILING?

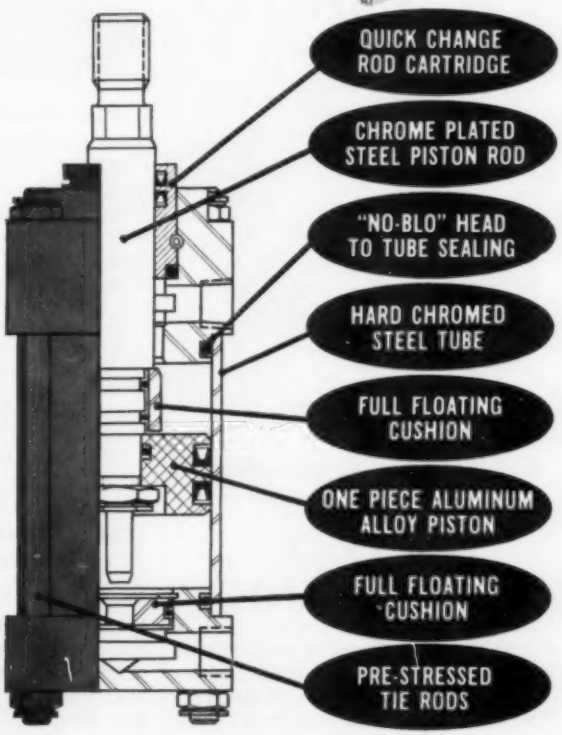
YOU, WHEN **YOU** DISCOVER THE DESIGN ADVANTAGES OF • • • •

LINDBERG

SQUAREHEAD CYLINDERS

DESIGN IN LINDBERG
AND . . . ADD ALL THESE
FEATURES!
and many more besides!




QUICK CHANGE ROD CARTRIDGE
CHROME PLATED STEEL PISTON ROD
"NO-BLO" HEAD TO TUBE SEALING
HARD CHROMED STEEL TUBE
FULL FLOATING CUSHION
ONE PIECE ALUMINUM ALLOY PISTON
FULL FLOATING CUSHION
PRE-STRESSED TIE RODS

CERTAINLY! Your choice of mounting styles • 7 bore sizes to 6″ • Built to JIC recommendations • Standardized mounting dimensions.

WANT TO SMILE AGAIN!

FOR DETAILS OF THESE AND MANY OTHER FEATURES, WRITE FOR THESE BULLETINS TODAY.

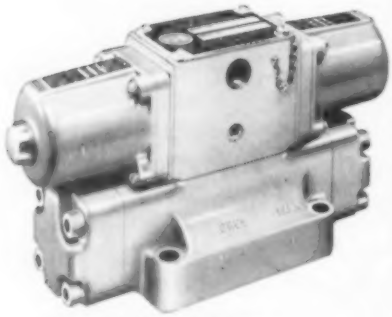
SQUAREHEAD "S" LINE—	BULLETIN S-101
2000 PSI "H" LINE—	BULLETIN H-101
HEAVY DUTY "A" LINE—	BULLETIN A-101

for fast action on "specials" tell us what you need.

LINDBERG AIR and HYDRAULIC DIV.
TEER-WICKWIRE & CO.
1802 WILDWOOD AVE. • JACKSON, MICHIGAN

Circle **131** on Time-Saver Card

NEW H-P-M ¾" PILOT-OPERATED SOLENOID CONTROLLED 4-WAY VALVES



3000 psi, 20 gpm

Smoother Acting, Longer Lasting, Oil-Immersed Solenoids

THE PRICE IS IMPORTANT!

►H-P-M's new pilot-operated valves are completely interchangeable with industry standards. Proved in use on fast cycle production machines. Oil-immersed solenoids, standard at H-P-M, lessen shock—are smooth and quiet in action — less wear — last longer. H-P-Ms cost only a few dollars more than conventional air-gap types.

AVAILABLE FROM STOCK FOR IMMEDIATE DELIVERY

Write for complete information, specifications and performance data.

THE HYDRAULIC PRESS MFG. COMPANY HPM

A Division of Koehring Company
Mount Gilead, Ohio, U.S.A.

Circle **72** *on Time-Saver Card*

NEW PRODUCTS

PRESSURE REGULATORS . . . in 2 new sizes

Designation: Series 20AR

Features: Brass bonnet and body, nylon-reinforced Buna N diaphragm and seat, hand-removable bonnet, inline pipe connections.

Can be serviced without removing from air line. Easily adaptable. Furnished with or without ⅛" NPT gauge port; 1½" diameter, and 160-psi capacity backmounted pressure gauge.

Specifications: In ⅛ and ¼ NPT sizes. Handles air to 20 cfm at 100 psi. Can be used at maximum primary pressure of 400 psi, delivery pressure of 100 psi. Top operating temperature is 200 F.

C. A. Norgren Co.
Englewood, Colo.

Circle **316** *on Time-Saver Card*

SPEED CONTROL VALVE . . . needle and ball check

Designation: Vari-Speed

Features: Combination needle and ball-check valve to control speed of single or double-acting air or hydraulic cylinder by restricting flow from exhaust end of cylinder during piston movement in one

direction. Movement in opposite direction unseats ball check, bypassing needle-valve section. No effect on incoming pressure or cylinder-output force. In free-flow direction, flow unrestricted around ball check. In controlled-flow direction, ball is seated and flow directed through restricting opening around needle valve.

Specifications: Aluminum valve bodies withstand pressures to 2000 psi. All other parts stainless steel. Needle has "O-ring" and lock nut. Pipe sizes from ⅛-¾".

Control Equipment
Cleveland, Ohio

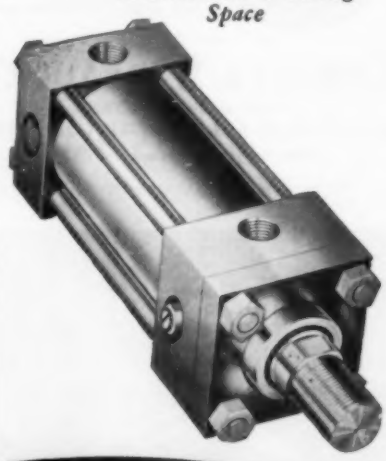
Circle **317** *on Time-Saver Card*

FLOW CONTROL VALVE . . . is easy to set

Designation: Colorflow

Features: Colored graduations on scale help adjust and reset valve

Maximum Working Force in Minimum Working Space



Milwaukee
Air or Hydraulic
CYLINDERS

- **Quality Construction Throughout**
- **No Costly Down Time**
- **Guaranteed Top Performance**
- **Precision Designed –Heavy Duty Service**
- **Conforms to JIC Specifications**

Get all the facts and see how Milwaukee Cylinders save space and weight . . . Save on original cost and save on maintenance.

Write today for Free Bulletins A-100 and H-100.

Standard Models
Hydraulic Bore Size 1½ to 12"
Air Bore Size 1½ to 14"
Specials built to your specifications

MILWAUKEE CYLINDER CO.
Division of L. & M. Machine Company

Circle **92** *on Time-Saver Card*

quickly. Colors prevent human error. Color graduation system designed so full turn of screw exposes another color. Screw graduated for setting. Guided poppet stem cuts cocking and insures accurate setting. Positive stop prevents needle from backing out. Poppet stop insures against spring damage, and set screw locks.

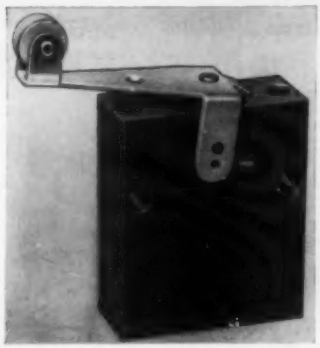
Specifications: Five standard sizes: ⅛, ¼, ⅜, ½, and ¾". Withstands pressures to 5000 psi. Internal and moving parts of stainless steel, valve bodies in brass, carbon steel, or stainless steel.

The Manatrol Corp.
Cleveland, Ohio
Circle **318** *on Time-Saver Card*

MINIATURE VALVE
. . . offers snap-action

Designation: Micro Valve

Features: Positive action in all fluids. No sliding seals, packing, or tight fitting moving parts to leak, wear out, or stick. Low-hum operation provided with spring-return type solenoid valve with low heat output. Snap-action operator allows full solenoid travel. Light weight. Tight shut-off.



Specifications: As light as 2 oz., sizes as small as ⅝x1½x1¾". Operating pressures from 0-100 psi. In 2, 3, or 4-way designs. Basic valve is 3-way, 2-position.

Instruments, Inc.
Tulsa, Okla.
Circle **319** *on Time-Saver Card*

AIR CYLINDERS
. . . of stainless steel

Features: Rolled in construction on front and rear head, so cylinder can be mounted in minimum space.

Continued on page 150

FILTER OUT FERROUS GRIT

Reduce Maintenance, Parts Replacement and Downtime with

FERROFILTER®

Magnetic Separators

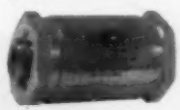
Frantz FERROFILTERS protect fluid power systems by removing microscopic ferrous particles which may pass freely through edge-type strainers and even escape conventional cartridge-type filters. FERROFILTERS help prevent sticking and nonfunctioning as well as wear and scoring of valves, pistons and other precision parts.

Model PQ-3 Low Pressure

100 psi working pressure . . . 20 gpm flow capacity . . . 12 lbs dry weight . . . 1" pipe connections, NPT . . . Others from 5 to 200 gpm and from ⅜" to 3" pipe connections.

Model P2H-50 High Pressure

5000 psi working pressure . . . 12 gpm flow capacity . . . 15 lbs dry weight . . . for ¾" tapered pipe, NPTF; also ¾" tube connection, Spec. AND-10050. Others rated at 2000 psi. Capacities up to 40 gpm.



Model PX-2 High Pressure

For aircraft and missiles . . . 3000 psi working pressure . . . 12 gpm flow capacity . . . 3 lbs dry weight . . . ¾-16NF-3 thread for ½" tube connection, Spec. AND-10050 . . . 5⅛" long; 2½" dia. Model PX-1 for 6 gpm, ⅜" tube.

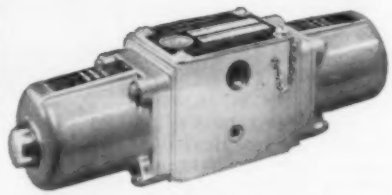
Write for Bulletin PM-65 and other literature

S. G. FRANTZ CO., Inc.

Brunswick Pike & Kline Ave.
P. O. Box 1138
Trenton 6, N. J.

Circle **48** *on Time-Saver Card*

NEW H-P-M ⅛" 4-WAY VALVES . . . with smoother acting . . . longer lasting oil-immersed solenoids . . .



H-P-M's New 3000 psi, 6 gpm, 4-way Valves, ⅛" Size, Solenoid Controlled

THE PRICE IS IMPORTANT

► As a pilot valve for the ¾" valves, illustrated on the opposite page, these sturdy ⅛" directional controls have been thoroughly tested on high speed production machines representing millions of cycles. *Not one single report of solenoid failure!*

Send, today, for complete information on this new, improved line of maintenance-free valves . . . built for 20 to 30 times the life expectance you've learned to live with . . . and available from stock for immediate delivery. These valves are interchangeable with industry standards.

THE HYDRAULIC PRESS MFG. COMPANY HPM

A Division of Koehring Company
Mount Gilead, Ohio, U.S.A.
Circle **154** *on Time-Saver Card*

NEW PRODUCTS

Specifications: Double acting, all strokes to 18". A 1½" bore cylinder exerts pressure of approximately 0.9 air line pressure. Will operate to 150 psi. Body, piston rod of stainless steel. Piston has two synthetic rubber U cups.

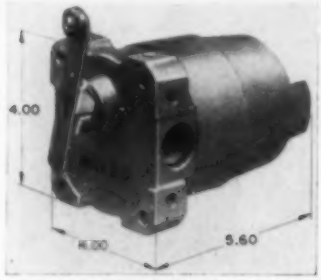
Bimba Mfg. Co.
Monee, Ill.

Circle **320** *on Time-Saver Card*

EXPLOSION-PROOF SWITCHES
. . . are rain-tight

Designation: Series CX

Features: Suitable for explosive



atmospheres and tested as rain-tight. Two enclosed single-pole, double-throw units may be wired NO or NC. Completely sealed.

Specifications: Electrical capacity is 20 amps., 125, 250, or 460 vac.

Micro Switch
Division of Minneapolis-Honeywell Regulator Co.
Freeport, Ill.

Circle **321** *on Time-Saver Card*

DOUBLE LAP FLARER
. . . is pneumatically operated

Features: Forms double lap flare on end of ferrous, non-ferrous tubing. Mounted on steel cabinet. A 3-position control lever picks proper control valve position and opera-

tion for power head. Tubing is positioned, clamped, and upset for flaring.

Specifications: Flares tubing of ⅛ through ½" O.D. with wall thicknesses of .028, .035, .042, and .049". Punches available for JIC standard 37° or automotive 45° flare. Operating pressure is 70-120 psi.

Parker Fittings & Hose Division
Parker-Hannifin Corporation
Cleveland, Ohio

Circle **322** *on Time-Saver Card*

PUMP AND MOTOR UNIT
. . . is close coupled

Designation: Series 42

Features: Use when space and

weight are at a premium. Totally enclosed electric motor rated for ½ to ⅓ hp. internel gear pump with capacity from ⅓ to 3 gpm. Built-in relief valve optional on all 24 models.

Specifications: Measures 9⅛x5".

Tuthill Pump Co.
Chicago, Ill.

Circle **323** *on Time-Saver Card*

Continued on page 152

Capital

HYDRAULIC FILTERS

for Hydraulic and Oil Re-circulating Machinery

Capital Hydraulic Filter Units are smaller than ordinary filters but with filtering capacity equal or superior to many larger filters. Small size permits greater latitude in design, particularly where space is restricted.

Capital Filter Units are designed with one-piece construction — no screws or nuts to work loose and be lost or mislaid. Simple and easy to clean by any method.

Made from specially designed woven Monel wire, with narrow corrugations presenting the greatest filtering area. Monel support supplies extra sturdiness.

Capital Filter Units are made in 4 Types:

- **MONO-BILT 60 Mesh All Stainless Steel (Sump type).**
- **MONO-BILT Standard All Stainless Steel**
- **MONO-ECONO Mono-Bilt with Monel Metal Insert and Cadmium Plated Top and Bottom.**
- **LINE TYPE with Aluminum Housing and Mono-Bilt, one Piece Filter Unit.**

Capital Line Type Filter

Built from Monel Metal they are impervious to rust and corrosion.

CAPITAL ENGINEERING & MFG. CORP.

5836 SOUTH ASHLAND AVENUE, CHICAGO 36, ILLINOIS

Circle **24** *on Time-Saver Card*

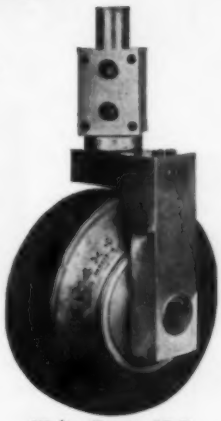
Circle **90** on Time-Saver Card

TOG-OIL®
Double-Acting, Toggle Linkage HAND PUMPS

- Variable Leverage Ratio up to 3.5:1
- Models for 1000, 3000, and 10,000 P.S.I.

HYDRO-WHEEL®
Makes Platform Lifts SELF-PROPELLED

- Gives 360° Steering
- Simple, Safe, Easy-to-Install



► Rotary Pumps
► Needle Valves
► 4 and 5 Way Valves

Write Dept. AP-7

MECHANISMS CO.
118 E. 2nd St.
Uhrichsville, Ohio

TRU-FLATE

THE "JET" | MOST EFFECTIVE AND ECONOMICAL AIRLINE BLOW GUN AVAILABLE

Eliminates Hand and Finger FATIGUE

MODEL NO. 404 X

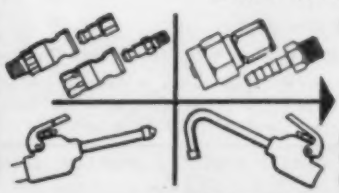
1.75 DEALER NET

An all-purpose blow gun with "positive" finger tip control — can be quickly and accurately adjusted from a mere whisper to a full scale blast of air by a slight turn of the nozzle. You get just the right amount of air, at the right time, at the right place.

Write for FREE Catalog

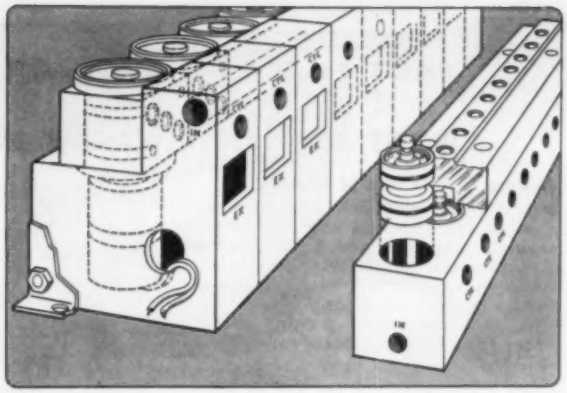
TRU-FLATE, INC.
888 - 92nd AVE. · OAKLAND 3, CALIFORNIA

■ Other *Tru-Flate* Industrial Products



■ Couplers and Nipples
Sleeve Type Series
"Push" Type Series
Interchange Series
Hydraulic Series
"Strait-Thru" Series
■ Reuseable Hose Fittings
■ Barb Type Hose Fittings
■ Blow Guns, Water Valves

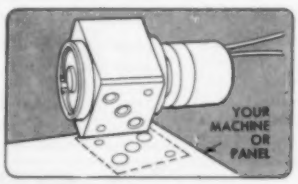
Circle **135** on Time-Saver Card



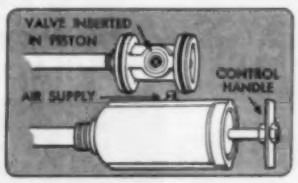
New Humphrey "Stack-Pack" Electric Manifold Valve. May be used singly or in multiples. Valve mechanism easily removed from manifold. Single inlet port for multiple installations.

Humphrey Exclusive! Manifold using Insert Valves. Just the internal mechanism of valve may be inserted in your manifold. Manual, cam or pilot operated.

HUMPHREY "Quick-Dump" VALVES
give you greater capacity—smaller size—faster action—more versatility and simplicity of design



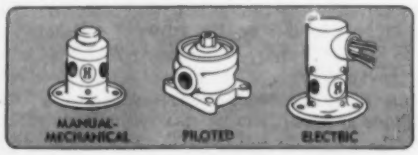
This may be the valve you need! Square bodied Electropact or piloted valve with all porting on one side to mate with drilled air* passages in your product, or—mount on panel with all porting on one side. Greatly simplifies installation.



For original equipment, "Quick-Dump" Valves offer outstanding advantages. This customer's air cylinder is operated by two Humphrey Valves inserted in piston itself! A turn or pull of handle controls piston travel.

OFFERED IN THESE BASIC TYPES—

ACTUATED BY ANY OF THESE METHODS—



***FOR AIR, WATER, OIL, GASES—TO 125 PSI**
⅛" delivers 30 CFM at 100 PSI • ¼" delivers 80 CFM at 100 PSI • ½" delivers 275 CFM at 100 PSI • Dead seal shut-off. Temperatures from -65° to 225° F. 2-3-4 way—⅛", ¼", ½" sizes. Write for engineering assistance on your valving problems.

SEND FOR BULLETIN 202A

Humphrey Products
DIVISION OF GENERAL GAS LIGHT COMPANY "The Heart of Automation"
202 N. PARK ST., KALAMAZOO, MICHIGAN
Pneumatic-Hydraulic Valves and Devices

Circle **69** on Time-Saver Card

ADAMS FACT FILE #2

PLANT AIR

Moisture Chief Cause of Trouble . . .

Every company today is looking for ways to offset the increased costs of labor, material, equipment and services. At a gasoline station you expect "Free Air", but in industry it is a major expense. Perhaps in your own plant, for an investment in a few minor compressed air system alterations, significant savings are possible.

Water, sludge, rust, oil and dirt in compressed air systems are prime causes of maintenance and production down-time. Water vapor condensing in air lines tends to corrode the piping. Also, water present in the piping may freeze during winter, causing serious reduction of compressed air supply. Such restrictions are often difficult to locate and thaw. This same line moisture may emulsify lube oil destroying its lubricating value and the resultant mixture has high fouling characteristics. Frequently, ice will form within the tool itself since expanding air cools the moisture . . . tool efficiency will be seriously affected.

Some of the Other Problems Created By Wet Compressed Air . . .

Wet compressed air is not only a construction and production tool problem. Faulty paint jobs, contaminated chemical and food products can often be traced to moisture laden compressed air. Waterhammer, unequal pipeline thermal expansion and line leaks also result from collected moisture. In addition, air lost through traps, and in blow-down of compressed air lines provide no useful work . . . represent a sizeable power loss.

You Can Lick Compressed Air Moisture Problem . . .

All of these hidden costs can be virtually eliminated by the installation of an Adams Aftercooler and Cyclone Separator between the compressor and receiver tank. By cooling discharge air to within 10° F. of cooling water temperature — guaranteed with Adams standard Aftercoolers — the moisture can be removed at the separator. Pressure loss is less than one-half pound on these units including the separator. In severe cases, moisture removal of over 90 per cent can be obtained by cooling the air with Adams 2° Aftercooler to within 2° F. of water temperature.

Air Filter for Final Protection at Point of Use . . .

As an added safeguard for expensive tools and equipment, an Adams Poro-Stone Air Filter should be installed just before the air is used. These filters remove all solid material picked up by the air stream. With an Adams Aftercooler, Cyclone Separator and Air Filters clean, dry, trouble-free air is supplied to your production tools. You get continuous service with minimum maintenance.

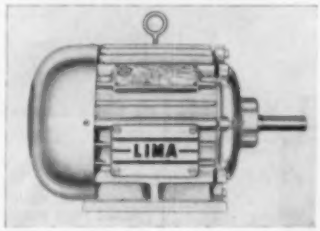
For further information on how the complete line of Adams air equipment can solve your compressed air problems, write today for your free copy of Bulletin No. 712 on Aftercoolers and Bulletin No. 117 on Poro-Stone Air Filters from the R. P. Adams Company, Inc., 249 East Park Drive, Buffalo 17, New York.

Circle **2** *on Time-Saver Card*

NEW PRODUCTS

ELECTRIC MOTOR . . . is fan-cooled

Designation: Type E



Features: For non-explosive atmospheres containing much moisture or abnormal amounts of dirt and dust. For horizontal, wall, or ceiling mount. Solid die cast aluminum rotors have dual fans, entire rotor assembly dynamically balanced. Double-width sealed ball bearings require no greasing or cleaning. Lubricant sealed in, dirt and moisture sealed out.

Specifications: Rigid, seasoned cast iron frames with integrally cast feet. Available in standard commercial frequencies and voltages below 600. From 1 hp, 900 rpm, to 40 hp, 3600 rpm.

The Lima Electric Motor Co., Inc.
Lima, Ohio

Circle **324** *on Time-Saver Card*

HYDRAULIC DISCONNECT COUPLING . . . in 3 configurations

Designation: Push-Pull

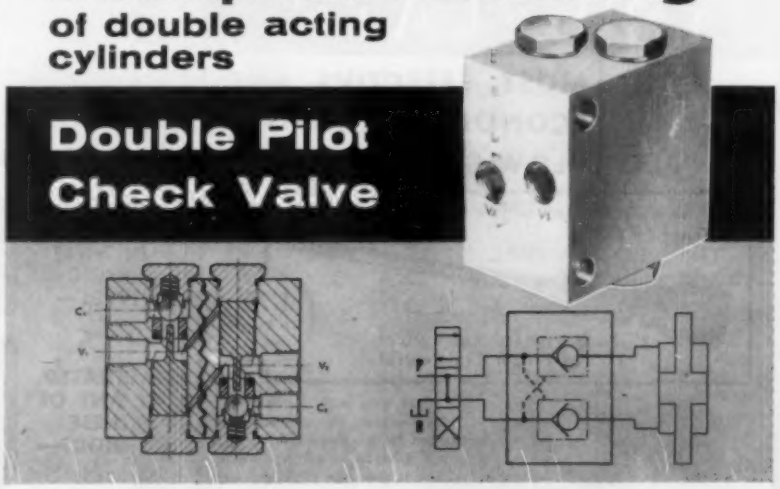
Features: For hydraulic systems with working pressures to 3000 psi. Seals positively, allows full fluid flow with small pressure drop. When installed in swivel break-

away frame, couplings swing 30° in any direction. This eliminates side thrust as source of coupling wear, because coupling pulls away exactly parallel to pull. Coupling disconnects easily.

Continued on page 154

Leakproof Locking
of double acting cylinders

Double Pilot Check Valve



- Allows use of inexpensive control valves
- Internally piloted—no external piping required
- Widely used on rotary actuators
  - Standard Ports — ¼", ⅜" and ½" pipe (NPTF)
  - For oil — 3000 psi

Write for detailed literature

Fluid Controls, inc.
Member of National Fluid Power Association

Manufacturers of Hydraulic Valves and Devices
Relief Valves • Check Valves • Restrictor Valves
Needle Valves • Pilot Check Valves • Special Valves
Pressure Compensated Flow Regulators

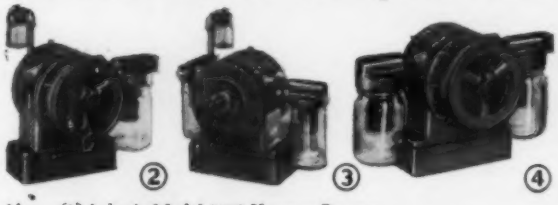
1284 N. CENTER STREET • MENTOR, OHIO

Circle **47** *on Time-Saver Card*

Circle **53** on Time-Saver Card

Need an original equipment VACUUM PUMP?

See how GAST cuts your costs



Above (1) is basic Model 1550 Vacuum Pump—(one of 13 sizes). For active customers, Gast builds this model in dozens of variations. Specific needs are met for vacuum, pressure, lubrication, drive and type of service.

For example, (2) is equipped for general purpose vacuum. (3) provides both vacuum and pressure for paper feeding. (4) oil-less model has carbon vanes; never needs oil. (5) has new constant level oiler for rigorous industrial duty.

You save because Gast *ingenuity* and *tooling and manufacturing efficiency* permit high quality at production prices.

WRITE FOR FULL DETAILS—REQUEST CATALOG

Gast Manufacturing Corp., P.O. Box 117-D Benton Harbor, Mich.

Circle **136** on Time-Saver Card

TRU-SEAL
TEFLON SEAL
PAT. PENDING
Saves hours in piping installations
Eliminates leaks in oil, air, water, vacuum, chemical lines
Tru-Seal saves hours in assembling piping installations because it enables you to run your pipe lines in any direction you wish, quickly and easily—without having to recut and re-thread piping sections. Wherever used on air, oil, water, steam, vacuum or chemical lines, it seals perfectly at —100° F. to plus 500° F.—*without the use of pipe dope*. Its installation requires only light tightening torque, thus eliminating over-tightening damage to valves, pumps, compressors, and other fittings.
For further information write
TRU-SEAL DIVISION
FLICK-REEDY CORPORATION
7N017 York Rd., Bensenville, Ill.
"Miller Fluid Power" is also a Div. of Flick-Reedy Corp.
1
Thread Tru-Seal on pipe or fitting as far as it will go hand tight.
SEAL SIDE
2
Thread pipe or fitting 3 threads into port. Point in desired direction.
3
Tighten Tru-Seal to complete leakproof assembly (only light torque required).

NEW Portable Flow Meter Checks Circuit Efficiency

PATENTS APPLIED FOR

One meter serves many circuits, is unaffected by viscosity change, and requires no piping

Operators of hydraulic circuits containing Tell-Tale® Filters can now *know* the exact degree of efficiency of their hydraulic components by checking flow rates periodically with the new Tell-Tale Flow Meter. The flow rate may be determined at those points in the circuit where Tell-Tale filters are installed (including pressure line filters to 5000 psi). In use, the meter utilizes the filter housing by replacing the filter cartridge. In only a few minutes flow rates are accurately determined under various conditions (i.e. under load and under no load to check pump slippage). No piping work or component removal is needed and the meter reads directly in gallons-per-minute. No conversion tables are necessary because readings are correct regardless of fluid temperatures or viscosities.

To the already impressive advantages of standardizing on Tell-Tale Filters (knowing *when* to clean the filter, easy access to filter cartridge, and positive protection against pump starvation) is now added the ability to know *when* and *where* there is leakage in the circuit. Tell-Tale Fluid Meters are available in five maximum capacities, from 10 to 200 gpm. Meter housings are also available for permanent installations. Write today for more information.

Above: Tell-Tale Flow Meter being placed into Tell-Tale Filter housing (mounted in suction line) to check pump slippage.

Below: Highly accurate, this meter operates like no other, on a variable-orifice, precise pressure-drop principle. In operating, the orifice (pointed out, below left) in the end of the piston is closed down until the flow is restricted enough to create a predetermined pressure drop that moves the piston forward. Movement is indicated by the when-to-clean pointer on the filter housing. Flow rate is then read from the graduated control wheel, in gallons per minute.

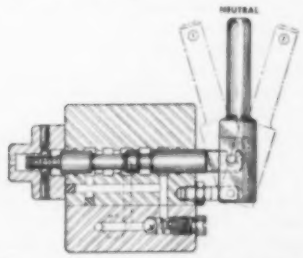
The ROSAEN COMPANY

1776 EAST NINE MILE ROAD • HAZEL PARK, MICHIGAN

new 10,000 psi FOUR-WAY VALVES

effortless operation for applications up to 10,000 psi

Have valving problems on hydraulic applications calling for high pressures up to 10,000 psi? This new GREENLEE Four-Way Valve may be your answer. Simple, trouble-free spool-type valve . . . completely balanced to provide effortless operation at any pressure in any position. It operates with the same ease at 10,000 psi as at 0 psi. Panel mounted for universal adaptability. Subplate available. Precision-made, precision-tested. (Max. leakage 4 cu. in. per minute at 10,000 psi.) Write today for illustrated data sheet.



GREENLEE Four-Way Valve is available in two models: No. 1717 (above) with detent-positioned control lever . . . No. 1704 with spring-centered control lever.

THE GREENLEE LINE ALSO INCLUDES A WIDE SELECTION OF HAND AND POWER-OPERATED HYDRAULIC PUMPS

GREENLEE

GREENLEE TOOL CO.
1776 Columbia Ave., Rockford, Illinois

Circle **56** *on Time-Saver Card*

NEW PRODUCTS

Specifications: No. 5600 couplings in ½, ¾ and 1" female pipe sizes; No. 5650 in ½ and ¾ sizes. Both ½" sizes connect to ⅜" male pipe with bushing. 5606 couplings have SAE hydraulic straight thread bosses and are 9/16, ¾, ⅞, and 1 1/16" sizes.

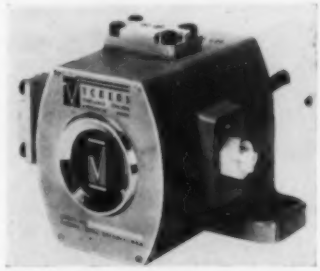
Aeroquip Corporation
Jackson, Mich.
Circle **325** *on Time-Saver Card*

USE A TIME-SAVER CARD FOR MORE INFORMATION ON

- ADVERTISED PRODUCTS
- NEW COMPONENTS
- USEFUL LITERATURE

VARIABLE DELIVERY VANE PUMP . . . to 1,000 psi

Features: Limits delivery to system demand, determined by mechanical adjustment. Pressure compensation may be varied from 200-1000 psi. Sharp cut-off enables pump to deliver nearly full volume up to



compensator setting, even at low operating pressures. Variable volume and pressure compensation features eliminate need for relief valve and piping.

Specifications: Nominal 5 gpm rating at 1800 rpm. Available for flange, foot, or gasket mounting.

Vickers Incorporated
Division of Sperry Rand Corp.
Detroit, Mich.
Circle **326** *on Time-Saver Card*

A FITTING FOR EVERY NEED
Specify
LENZ
O-RING
J.I.C. Approved TUBE FITTINGS
Select From A Complete Line!
Tapered or S.A.E. Str. Thread
J.I.C. 2 and 3 Pc. 37° Flares
Pipe Fittings • Accessories
You can't beat LENZ Tube Fittings for time saving and complete fitting assurance on any air, hydraulic or piping system installation. You get the finest quality from a specialist devoted exclusively to the manufacture of Steel Tube, Hose and Pipe Fittings.
Free Write for our newest complete line catalogs . . . ask to be put on our mailing list.
LENZ
NO METAL TO METAL SEAL
NO EXACT TUBE LENGTH NECESSARY
THE HIGHER THE PRESSURE THE TIGHTER THE SEAL
NOT NECESSARY TO CUT TUBE SQUARE
SEAL AND GRIP ARE SEPARATE
ABSOLUTELY LEAKPROOF CONNECTIONS
HELD BY FRICTION GRIP OF THESE TWO
EVERY JOINT IS A UNION
A HACKSAW AND FILE . . . ONLY TOOLS NEEDED
Patented • Patents Pending
For Nearest Distributor—See Thomas' Register A - Z Sec. Vol. IV—and Catalog Insert in Fluid Power Directory
LENZ COMPANY
3303 Klepinger Drive
Dayton • Ohio Phone CR 7-9364
Distributors in Principal Cities

Circle **83** *on Time-Saver Card*

Circle **27** on *Time-Saver Card*

STAFFA

HIGH TORQUE SLOW SPEED HYDRAULIC MOTOR

The STAFFA 30 h.p., 50 r.p.m., hydraulic motor operates at a working pressure of 1,500 p.s.i. with an overall efficiency of 93 per cent. Suitable for drives for CONVEYORS, WINCHES, HOISTS, CRANES, CAPSTANS and all MECHANICAL HANDLING Applications.

Ask for details of hydraulic cylinders, valves, pumps and motors.

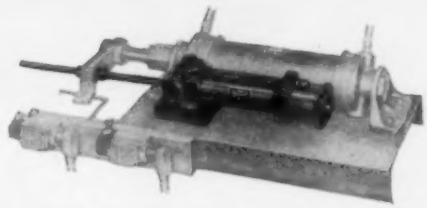
CHAMBERLAIN INDUSTRIES LTD

Staffa Works, Staffa Rd., Leyton, London, E.10, England.
Leytonstone 3678

(*Member of the Chamberlain Group of Companies*)

Circle **94** on *Time-Saver Card*

VERI-TROL HYDRAULIC CHECKING CYLINDERS



— designed for use with air cylinders to smooth out stroke variations due to compressibility of air under irregular load conditions.

- **ACCURATE SPEED CONTROL is dial-set, load-compensated to assure uniform stroke speed even with irregular loads.**
- **VISIBLE OIL RESERVOIR, easy to refill.**
- **2,000 LB. CHECKING CAPACITY on out stroke, free return.**
- **2", 4", 6", 9", 12", 15" and 18" checking stroke lengths.**
- **IDEAL FOR LOW-COST TOOL OR WORK-PIECE FEEDS.**

34 Take the bumps and jumps out of air cylinder operation — install VERI-TROL checking cylinders wherever you want smooth, accurately-controlled stroke speed. Write now for free data bulletin.

Modernair CORPORATION

Dept. B-7, 400 PREDA STREET, SAN LEANDRO, CALIF.
5007 Brookpark Rd., Cleveland 34, Ohio

HYDRAULIC ENGINEERING FOR INDUSTRY

CARDWELL

TRADEMARK SINCE 1829

DESIGN SERVICES
FABRICATION
POWER UNITS
HYDRAULIC PANELS
ELECTRICAL CONTROL PANELS
ACCUMULATORS
STOCKING DISTRIBUTORS
HYDRAULIC COMPONENTS

Complete Engineering and Design Services Are Available. Qualified Sales and Service Engineers in Most Areas.

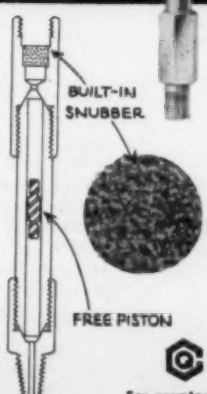
The **CARDWELL MACHINE COMPANY**
Quality A CARDWELL TRADITION SINCE 1829
Franklin at 19th St., Richmond 11, Virginia • Phone Milton 4-4593

Circle **25** on *Time-Saver Card*

Chemiquip's

a NEW concept in PRESSURE INSTRUMENT PROTECTION
WORKER SAFETY

FLOW CHECK SNUBBER



Now, a simple, self-contained, low-cost, foolproof method of protecting valuable instruments . . . preventing the escape of noxious, toxic or flammable gases and liquids in the event of rupture in the pressure instrument system.

- **Will withstand pressures up to 30,000 psi**
- **Completely isolates instrument from the pressure transmitting media**
- **Works equally well with instruments actuated by bourdon tubes or diaphragms**

And, Chemiquip's built-in snubber

- **Prevents transmission of line surges and pulsations**
- **Never plugs or clogs**

For greater plant and/or instrument efficiency, write, wire, phone NOW for detailed Bulletin BW-741.

CHEMIQUIP CO.

36 East 10th Street, New York 3
GRamercy 7-3772

Circle **28** on *Time-Saver Card*

Typical Control Functions solved by AIR CIRCUITRY

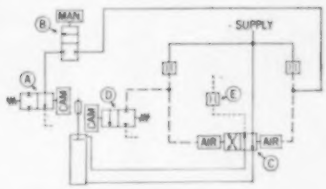
Westinghouse Type "D" Pilotair Valve

Another of Westinghouse Air Brake's many AIR CIRCUITRY components, the "D" PILOTAIR® Valve is a spool-type directional valve that can be operated by a lever, button, cam, solenoid, air pilot, pedal or treadle. Valves available in two, three, and four-way operation, two and three position, open neutral, lap neutral and vented neutral. Port sizes are ¼" and ½" ips. Operators may be on either or both ends. Max. operating pressure: 250 psi.

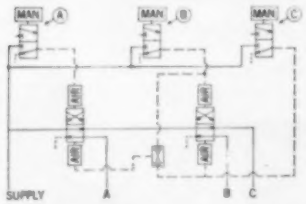
DESIGN FEATURES. A new design of seal and segment construction gives the "D" PILOTAIR® Valve increased capacity and requires a minimum of maintenance. By rotating operators, their mounting brackets and any of their ports in 90° steps, over one-hundred thousand combinations may be obtained. They operate in any position with air, gas, water and most oils. The "D" PILOTAIR® Valve can satisfy any of your directional valve needs. For more information, ask for catalogue A4-75.01.

What is AIR CIRCUITRY?

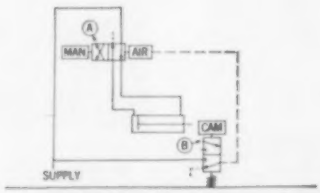
This is the Westinghouse term for application of pneumatic control systems to industrial production operations. Safe, economical, precise Air Circuitry is now being used to solve the most rigorous and complex control problems in industry. Westinghouse Air Brake has pioneered the application and development of air control for more than 80 years. Today our engineers can design an air circuit which will boost production and cut costs.



1. AUTOMATIC CYCLING—Supply air flows to the cylinder to extend the cylinder rod and actuate cam operated valve "A." By operating valve "B" air is bled from the right-hand air pilot of valve "C" to operate this device and retract the cylinder rod. This actuates valve "D" and reverses the process. Cycling time may be changed by regulating the FLOREG® valve "E." The stroke is set by moving the cams on the cylinder rod.



2. STATION TRANSFER—Any of the three stations may capture supply air for the station by operating its respective valve. This may be expanded to any number of stations.



3. AUTOMATIC RESET—To reset the operating valve "A" after completion of an operation. Moving the manual operator admits supply air to the cylinder to extend its rod. At the end of the cylinder rod stroke cam operator valve "B" is actuated to connect supply air to the air pilot operator of valve "A." This returns this valve to its original position. Supply air is then connected to the cylinder to retract the cylinder rod. The circuit is now ready for recycling.

See the Yellow Pages under Cylinders for the Name of Your Local Distributor

WESTINGHOUSE AIR BRAKE COMPANY
INDUSTRIAL PRODUCTS DIVISION, WILMERDING 6, PENNSYLVANIA

Circle **147** on Time-Saver Card

USEFUL LITERATURE

VALVE LINE

Featured in Catalog KS-1. Covers line of small valves for general application. Working pressures, specifications, construction features, and suggested applications. *Kerotest Manufacturing Co., Pittsburgh.*

Circle **410** on Time-Saver Card

SWITCH GUIDE

For engineers and designers. Bound reference catalog on electrical switches and actuators. Articles on switch terminology, basic design types, operating methods, environment application data. Also

photos, dimension drawings, specifications and modification information. Covers many types of switches, actuators. Supplemental material will be issued to keep catalog up-to-date. Catalog ES-59, 52 pages. *Electrosnap Corporation, Switch Division, Chicago.*

Circle **411** on Time-Saver Card

TUBULAR PIPING

Cataloged by dimension, size, and weight. Sizes ⅛ through 36" given for all schedules. Data card TDC-191. *Tubular Products Division, The Babcock & Wilcox Co., Beaver Falls, Pa.*

Circle **412** on Time-Saver Card

CHECK VALVES

Hard or soft seat. Bulletin HA02 shows product photos, dimension tables, drawings, specifications, ordering instructions. Back page shows recent applications. *Sealol Corp., Providence, R.I.*

Circle **413** on Time-Saver Card

Continued on page 158

Circle **125** on Time-Saver Card

FASTER CYCLING

NEW IMPROVED

C4H *SERIES*

"FINEST... of the INTERCHANGEABLES"

Sheffer pioneered tapered cushions eliminate shock conditions on cushion entrance — permit faster cycling — greater production. BORES up to 30" — STROKES to 26 feet, on application.

Write NOW for Bulletin 658

- 2000-3000 psi HYDRAULIC
- ALL STEEL CONSTRUCTION
- EASILY REMOVED ROD CARTRIDGE
- BORES 1¼ thru 12
- 17 MOUNTINGS
- MEETS or EXCEEDS J.I.C.

THE SHEFFER CORPORATION

NFPA

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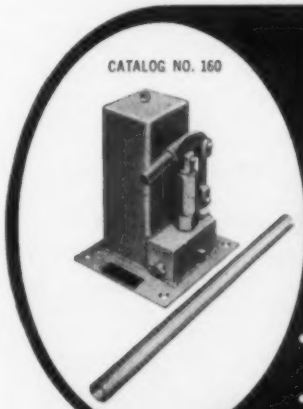
SEE PHONE BOOK YELLOW PAGES

CATALOG NO. 160



Hand Hydraulic Pumps

- Single and Double Designs to 20,000 psi
- With or Without Reservoir

160 cubic inch reservoir with 8"x 8" base plate and 18" long handle.

Available with optional size pistons ⅜", ½", ¾", 1" and 1½".

We specialize in the manufacture of hand pump units which operate in temperatures from −65° F. to +160° F. and with any capacity reservoirs required. Pumps can be furnished on special order with custom seals to handle various aircraft types of fuels such as Pydraul, Skydrol, Oronite, etc.

The single pump with ½", ¾", 1" or 1½" piston is now available in stainless steel.

for additional information write:

WILLIAM S. PINE

hydraulic hand pumps for 1001 uses

1635 East 22nd St., Los Angeles 11, Calif.

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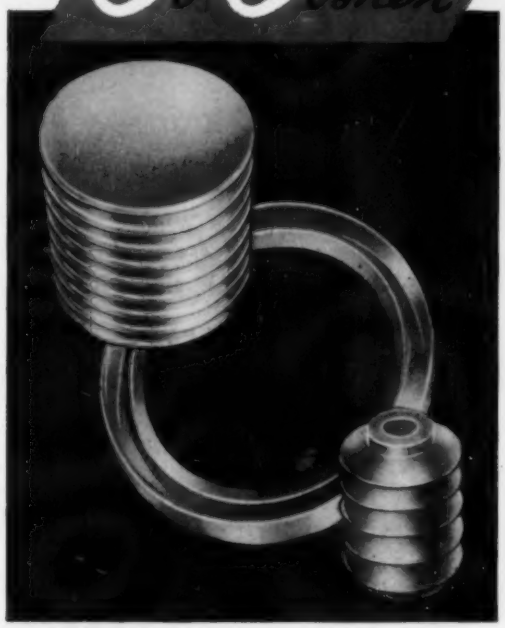
SILICONE

RUBBER SEALS, PARTS, COMPONENTS

Go Goshen



PROFIT from GRC's advanced techniques in

COMPOUNDING • MOLDING
LATHE CUTTING • BONDING-TO-METAL

Goshen-developed silicone rubber compounds assure parts with properties like these:

- Resistance to temperature extremes of −80°F to +500°F.
- Resiliency over a range of −120°F to +600°F.
- Low compression set.
- Resistance to chemicals, oxidation, ozone, moisture, corrosion, shock, abrasion.
- Freedom from stain, odor, tackiness and toxicity.

To learn for yourself why more and more design engineers "Go Goshen" for silicone rubber parts, write, wire or phone.

Goshen Rubber Co., Inc.

1379 S. TENTH ST. GOSHEN, INDIANA

Circle **55** on Time-Saver Card

USEFUL LITERATURE

AIR, VACUUM PUMPS

A 16-page Catalog 359. Also includes gas boosters, air motors. Details of construction, dimensions, capacities, new performance curves, installations. Included in catalog are 2, 4-vane pumps; fan-cooled, water-cooled, and radiator air-cooled models; motor driven units; direct-coupled and belt-driven models; integral pump and motor; automatically controlled tank units, and full line of accessories. *Leiman Brothers, Inc., Newark.*

Circle **414** on Time-Saver Card

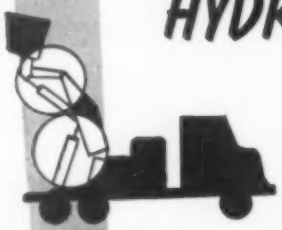
CYLINDER TUBING

Ready to use for hydraulic cylinders after cutting to length. Many application photos, descriptions. Includes tolerances for O.D. and I.D., mechanical properties. *Tube Reducing Corporation, Wallington, New Jersey.*

Circle **415** on Time-Saver Card

ON THE JOB...

with CROSS HYDRAULIC CYLINDERS



Stay "on the job" with dependable, rugged Cross Hydraulic Cylinders. Like Cross customers everywhere, you too, will appreciate the fast, courteous, dependable service you get from Cross. Phone for speedy delivery on any quantity...quality-built to your specifications. Contact Cross Engineering Department, today!

- RUGGED
- DEPENDABLE
- ECONOMICAL

CUSTOM DESIGNED CYLINDERS FOR EVERY APPLICATION

Try CROSS CYLINDERS in your operation... low cost, dependable, and trouble free.

Lowest-Priced Engineered Quality Cylinders Available..

trade mark of Quality in Hydraulic Cylinders...

HYDRAULIC CROSS CYLINDERS

CROSS MANUFACTURING CO.
LEWIS, KANSAS — PHONE EA 4-5525

WRITE • WIRE • PHONE...TODAY!!

Circle **35** on Time-Saver Card

HAND PUMPS

Specifications for pump hydraulic jacks, single and double plunger hand pumps, and double-acting air engine pumps. Product photos, diagram drawings, applications. *Forge and Fittings Division, H. K. Porter Co., Inc., Roselle, N.J.*

Circle **416** on Time-Saver Card

SUBMINIATURE SWITCH

For variety of rigorous services. Details on high temperature (650 F) switches and metal enclosed, environment-free switches. Also phenolic-cased, push-button, toggle, and integral-actuator subminiature switches. Pictorial index shows where to find dimensioned drawings, descriptions, force and movement specification tables and electrical ratings. Data on bases, terminals, circuit arrangements and NEMA glossary of terms. Catalog 159. *Unimax Switch Division, The W. L. Maxson Corp., Wallingford, Conn.*

Circle **417** on Time-Saver Card

VANE PUMPS

In T1D and TG Series. Bulletins give sizes, basic components, operating characteristics, dimension drawings. T1D includes data on changing shaft rotation, flange or bracket mountings. Both bulletins discuss "floating cartridge" construction. *Denison Engineering Division, American Brake Shoe Co., Columbus, Ohio.*

Circle **418** on Time-Saver Card

LUBRICANT SELECTOR

In chart form. Each type of Molykote described, evaluated as to temperature, environment, method of application, and incorporation into common materials. Distributor list. Bulletin 121 *The Alpha-Molykote Corporation Stamford, Conn.*

Circle **419** on Time-Saver Card

MINIATURE AIR COMPONENTS

Includes cylinders, valves, valve operating solenoids, fittings, and accessories. For automated circuits or semi-automatic tooling and control. Bulletin 4-59 lists 56 items in variety of bore sizes, styles, mountings, and voltages. Dimensioned diagrams, specifications. *Clippard Instrument Laboratory, Inc., Cincinnati.*

Circle **420** on Time-Saver Card

PRESSURE SWITCH

A 36-page design handbook and catalog which shows complete Meletron line. Describes diaphragm, bourdon tube, or piston switches. Detailed information on electrical and operating characteristics. Also ordering chart, adjustment directions, spare parts table, dimensioned diagram. Includes glossary, selection chart, electrical rating tables, maintenance checklist. Bulletin 9-PS. *Barksdale Valves, Los Angeles.*

Circle **421** on Time-Saver Card

TURBINE FLOWMETER

For measuring oil and other liquids over wide range of temperatures (-445 to 1000 F) and pressures (to 5000 psi). Bulletin 1384 includes photos and drawings, specifications, flow ranges and dimension tables. Ordering instructions included. *Cox Instruments Division, George L. Nankervis Co., Detroit.*

Circle **422** on Time-Saver Card

AIR HOSE FITTINGS

For many applications as shown in Bulletin 198. Sizes, part numbers, weights given for brass nipples, couplings, menders, female couplings and nipples, ferrules, and coupling adapters. *Hose Accessories Co., Philadelphia.*

Circle **423** on Time-Saver Card

LIMIT SWITCH

First small machine tool switch with a heavy-duty latch mechaism, eliminating over-the-center snap springs. Booklet has actual-size, exploded view of switch with parts identified. Dimensioned drawings shown for three models. Normal ac, dc inrush ac ampere ratings given for standard voltage specifications. Installation photos, ordering instructions, list prices, factory representative lists included. Bulletin M-1 on Model M. *R. B. Denison Mfg. Co., Cleveland.*

Circle **424** on Time-Saver Card

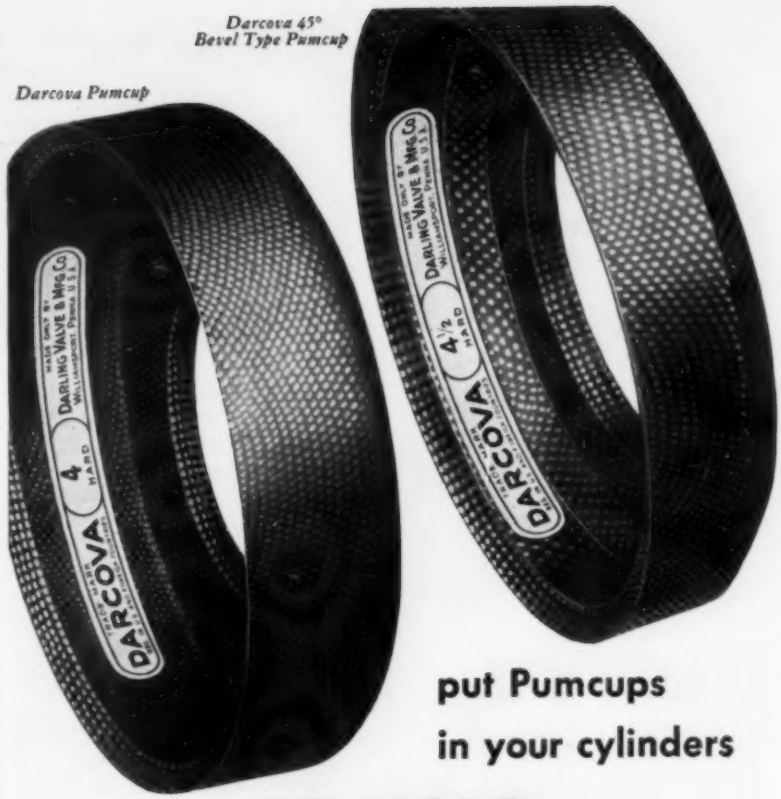
PRESSURE REDUCING VALVE

Has dead end shut-off, self-lapping action. Offers close control, long service life, eliminates chatter, cuts down wire drawing. Requires no lubrication or special tools. Label drawing, dimension and weight table. Capacity charts and pressure ranges by valve size. Sliding gate idea thoroughly explained. Bulletin J-160. *OPW-Jordan Corp., Cincinnati.*

Circle **425** on Time-Saver Card

Darcova 45° Bevel Type Pumcup

Darcova Pumcup



put Pumcups in your cylinders

TO HOLD PRESSURE LONGER!

In Darcova Pumcups a sound engineering principle has been combined with precision tolerances and extremely durable compositions to provide exceptional efficiency and life in hydraulic, air, and reciprocating pump cylinders of all kinds.

Unlike ordinary piston packing, precision Pumcups are engineered to minimize friction load while hugging cylinder walls on every pressure stroke. Regardless of eventual wear, efficiency *stays* high! So there's far less down-time and need for replacement.

Pumcups are made in a wide range of sizes, types and texture-engineered compositions, including 100% Nylon, for all kinds of pressure-temperature-fluid conditions. Send for Pumcup Bulletin 5503 and weigh all the facts!

DARLING VALVE & MANUFACTURING CO.
Williamsport 15, Pa.

DARCOVA
THE ORIGINAL COMPOSITION CUP
TRADE MARK
PUMCUPS

Circle **37** on Time-Saver Card

Pressures to 2500 PSi

Output from 1-60 GPM

DOWTY

Pressure Balanced

Hydraulic Gear Pumps

Features: Pressure balanced self-compensating design minimizes internal leakage . . . unique cartridge construction . . . high output to weight ratio . . . 14 sizes in 4 model groups . . . superior performance over wide range of operating speeds, pressures, temperatures and oil viscosities.

Applications: Road building machinery, farm equipment, fork lift trucks, power shovels, presses, machine tools, dump trucks and many more. Developed and proved in England and now available in the United States from:

BERRY HYDRAULICS

A Division of Oliver Tyrone Corp.

MAIL FOR COMPLETE DATA

Berry Hydraulics
2237 Oliver Building,
Pittsburgh 22, Pa.

Name_____

Company_____

Address_____

Circle **22** on *Time-Saver Card*

POST SCRIPTS OF INDUSTRY

News about people, manufacturers and sales organizations

2 field engineers named by Denison

James T. Howland and Thomas R. Reagan have been named field engineers for the Denison Engineering Division, American Brake Shoe Co., Columbus, Ohio. Howland, a graduate of Loras College, has been assigned to the midwest sales office, Chicago. Reagan, a graduate of Wayne University, is assigned to the Detroit sales force. In another move, Bruce R. Horne, a field engineer in New England for Denison for five years, has been transferred to the home office. He'll handle military applications.

Howland

Reagan

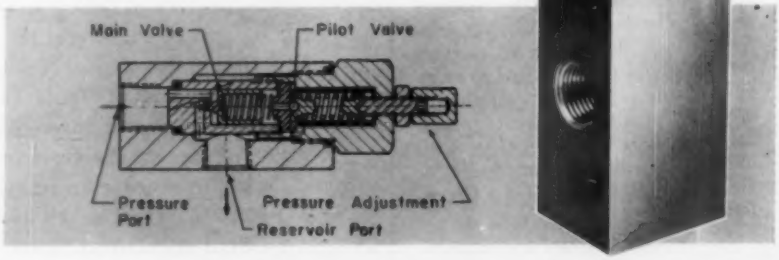
Finlayson is sales manager

Don Finlayson has been appointed sales manager in the Chicago area for Republic Mfg. Co., Cleveland.

Continued on page 163

Constant Pressure regardless of flow variations

Pilot Operated Relief Valve



- **Accurate pressure control assures efficient circuit**
- **Positive sealing before cracking**
- **Can control pressure within 3% of setting**
- Standard Ports — ¼", ⅜", ½" and ¾" pipe (NPTF)
- For oil
- Adj. Ranges: up to 4000 psi.

Write for detailed literature

Fluid Controls, inc.

Member of National Fluid Power Association

Manufacturers of Hydraulic Valves and Devices

Relief Valves • Check Valves • Restrictor Valves
Needle Valves • Pilot Check Valves • Special Valves
Pressure Compensated Flow Regulators

1284 N. CENTER STREET • MENTOR, OHIO

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Circle **65** on Time-Saver Card

Helicoid Gages give ***Sustained Accuracy,*** even on the toughest jobs

★ Exclusive Helicoid movement has no gears, no teeth. Shock-proof construction protects accuracy through millions of cycles.

★ Bourdon tubes available in four materials—bronze, steel, stainless steel, and K Monel—won't stretch, crack, or leak.

★ Six cases, including new solid-front safety case, meet every mounting requirement.

★ External pointer adjustment can't be jarred out of position.

★ A complete selection of gages and accessories for hydraulic, chemical, and other service.

Write for Catalog G-52.

HELICOID GAGES

Helicoid Gage Division
American Chain & Cable Company, Inc.
929-H Connecticut Avenue • Bridgeport 2, Conn.

ACCO

2568

REMOVE MOISTURE from

COMPRESSED AIR LINES

Air operated tools, instruments and controls demand air that is

COOL CLEAN & DRY

and the

MURPHY AFTERCOOLER SYSTEM
GUARANTEES IT!

Write now for **FREE** Data Sheet No. 2568.

JAMCO

JAS. A. MURPHY & CO., INC.
1417 EAST HIGH STREET, HAMILTON, OHIO

Circle **96** on Time-Saver Card

NEW!

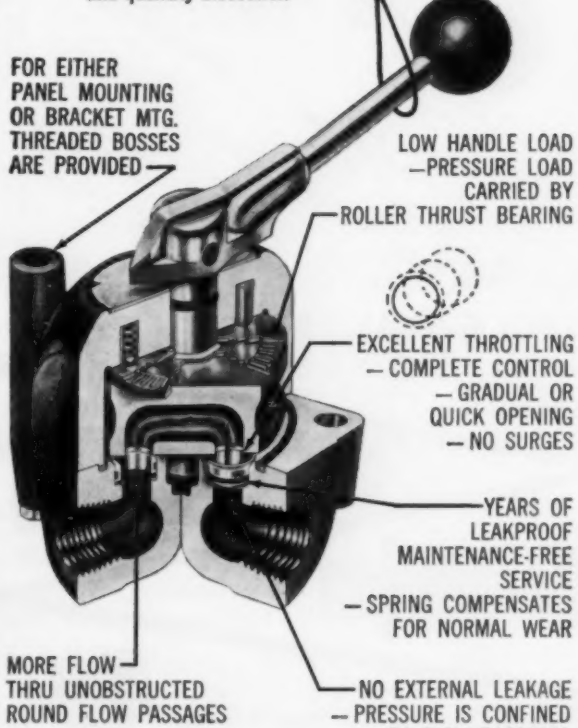
A "*SHEAR-SEAL*" VALVE

for LESS than a spool valve

RATED FOR 3000 P.S.I. OIL SYSTEMS

$65.00
List Price*
for a ¾" valve

*Less the usual O.E.M. and quantity discounts.


FOR EITHER PANEL MOUNTING OR BRACKET MTG. THREADED BOSSES ARE PROVIDED
LOW HANDLE LOAD —PRESSURE LOAD CARRIED BY ROLLER THRUST BEARING
EXCELLENT THROTTLING — COMPLETE CONTROL — GRADUAL OR QUICK OPENING — NO SURGES
YEARS OF LEAKPROOF MAINTENANCE-FREE SERVICE — SPRING COMPENSATES FOR NORMAL WEAR
MORE FLOW THRU UNOBSTRUCTED ROUND FLOW PASSAGES
NO EXTERNAL LEAKAGE — PRESSURE IS CONFINED TO FLOW PASSAGES

For complete data on this new valve and for information on all your valve requirements write for Catalog V-59-60

CONTROL VALVE DIVISION

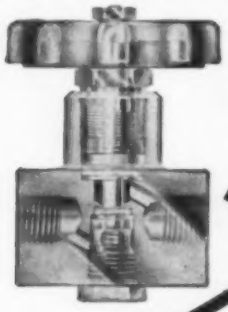
Barksdale valves

5125 ALCOA AVENUE • LOS ANGELES 58 • CALIFORNIA

Circle **18** on Time-Saver Card

NEW MODEL 949T
MANUAL SHUT-OFF VALVE

...for superior valve leakage control by Circle Seal



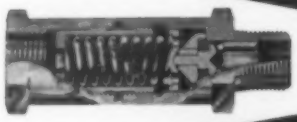
CIRCLE SEAL

...easier operation with threads out of fluid stream, reduced operating torque...increased handle finger or detent depth and flow passages...for high or low pressure gas service...rated at 0-5000 psi

CIRCLE SEAL VALVES

provide proven 100% reliability...

Check Valves



Inline Relief Valves

Popoff Relief Valves

Shutoff Valves

These and other standard and special valves are available for virtually all of your exacting service requirements.

CIRCLE SEAL

Complete engineering data available. Write today!

CIRCLE SEAL PRODUCTS COMPANY, INC.
2181 East Foothill Boulevard
Pasadena, California

See Our Catalog in Sweet's Product Design File

Circle **155** on Time-Saver Card

Circle **59** on Time-Saver Card

GRESEN HYDRAULICS

DOUBLE SELECTOR VALVE

Model DS-75

FEATURES: Cast iron body—chrome plated, pressure balanced spool—Easy to mount —Three optional handle positions.

SPECIFICATIONS: Capacity—24GPM @15 ft/sec.
Pressure range—0 to 1500 PSI
All openings—¾" NPT
Shipping weight—12 lbs.

WRITE FOR LITERATURE

GRESEN *Mfg. Co.*
405 35th Ave. N.E., Minneapolis 18, Minn.

AIR-MITE AIR CYLINDERS

Compact—
Powerful—
Rugged—
Low Cost!

AIR-MITE Cylinders—made in Single or Double Acting Series, in 4 mounting types, are high quality cylinders at a low price. Simple, rugged design and compact construction give them long life, permit easy mounting on jigs, fixtures, tools, or machines. Used wherever power holding, pushing, pulling, or lifting is required, AIR-MITE Cylinders will meet your most exacting requirements of dependability and long life. Write for complete catalog and prices.

QUALITY FEATURES:

1. Ground and polished steel ram
2. Brass, true-bore cylinders
3. High strength aluminum alloy cylinder heads
4. Bronze oilless ram bushing
5. Five steel tie rods

AIR-MITE DEVICES, INC.
4401 W. Kinzie St., Chicago 24, Ill.

Circle **6** on Time-Saver Card

Boni is zone manager

Boni

F. J. Boni is a new zone manager for the Wilkerson Corp. Boni's territory will be Eastern Pennsylvania, Southern New Jersey, Delaware and Maryland. The new manager was a manufacturer's representative for 11 years before organizing the Air Flow Co., Inc. He will retain his position as president of his own firm.

Owatonna forms hydraulics division

A new Precision Hydraulics Division has been formed by Owatonna Tool Co., Owatonna, Minn. The unit was created to concentrate on the hydraulic portion of the regular line of tools and hydraulic maintenance equipment. Hydraulic pumping units for the OEM market will also be designed and manufactured.

Nielsen opens office

A new office and warehouse has been opened by Nielsen Hydraulic Equipment, Inc., Pelham Manor, N.Y. and West Hartford, Conn. The new branch is located at 1429 East Elizabeth Ave., Linden, N.J.

Edgar is new division manager

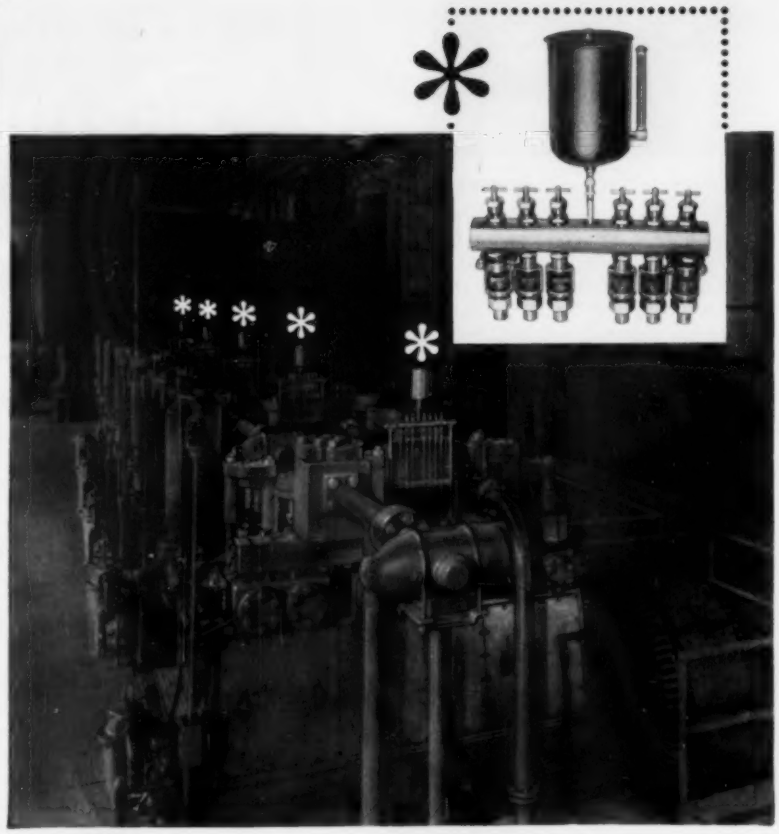
Edgar

Robinson F. Edgar is the new marketing manager of the Industrial Hose Division at Flexonics Corp., Maywood, Ill. For 12 years Edgar worked for Warner Electric Brake and Clutch Co., Beloit, Wis. He will be located in Rock Falls, Ill., division headquarters.

Hurd appointed district manager by Jamesbury

W. G. Hurd has been named district manager by Jamesbury Corp., Worcester, Mass. His headquarters will be in Atlanta, Ga. Before joining Jamesbury, Hurd was part owner of a mechanical contracting firm in Florida.

Continued on next page



NUGENT

MULTIPLE GRAVITY OILERS
Provide Controlled Lubrication
for hard-to-reach bearings

The five Worthington Power Pumps shown above supply hydraulic power for a central hydraulic accumulator system in a large aluminum mill.

Each pump is equipped with a Nugent Multiple Gravity Oiler. The feeds may be individually controlled to deliver lubrication in predetermined quantities to otherwise inaccessible bearings.

Nugent Multiple Gravity Oilers are available with 2 to 23 feeds. Pressure Sight Flow Lubricators are also part of a full line of Nugent lubricating specialties. Before you decide on any filtration or lubrication equipment . . . see what Nugent has to offer.

ESTABLISHED 1897

REPRESENTATIVES IN PRINCIPAL CITIES

WM. W. NUGENT & CO., INC.
3432 CLEVELAND STREET, SKOKIE, ILLINOIS

OIL FILTERS • STRAINERS • TELESCOPIC OILERS
OILING AND FILTERING SYSTEMS • OILING DEVICES
SIGHT FEED VALVES • FLOW INDICATORS

Circle **99** on Time-Saver Card

POST SCRIPTS OF INDUSTRY

Sheffer adds 4 distributors

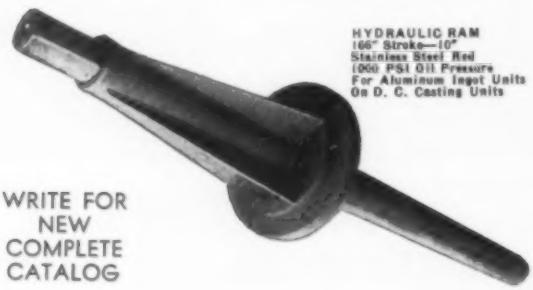
Four new midwestern and eastern distributors for The Sheffer Corp., Cincinnati, have been named. For Minnesota, the new agent is Hydra-Power Engineering, Wayzata; in Eastern Missouri and Southwestern Illinois, John Henry Foster Co., St. Louis; in Northwestern Pennsylvania, Ralph A. Hiller Co., Pittsburgh, and for Maryland and Washington, D. C., N. B. Cochrane Co., Baltimore. Products include air and hydraulic cylinders, boosters, and hand-operated hydraulic pumps.

Forster is promoted

Walter R. Forster has been promoted to Engineering Manager for the Industrial Products Division, Westinghouse Air Brake Co., Wilmerding, Pa. For the last three years he has been assistant chief engineer, in charge of the engineering department. Forster joined the company in 1947.

Lincoln AIR AND HYDRAULIC Cylinders

The answer to the increased demand for rugged, heavy duty air and hydraulic cylinders. Designed for the hardest usage in Steel Mill operation or for the hundreds of other modern cylinder applications that require dependable efficient service.



WRITE FOR NEW COMPLETE CATALOG

Lincoln MACHINE CO. INC.

P. O. Box 272 EDgewood 2-4689 Salem, Ohio

Circle **84** on *Time-Saver Card*

Vickers makes 3 changes

Milton Shapiro recently was named manager of the new market research department. Shapiro has held a similar position for the Machinery Hydraulics Division since 1957. R. H. Mezger is new manager

Shapiro

Mezger

Dodds

of the Worcester, Mass., Industrial Sales office. He has been with Vickers 17 years, and was formerly head of the St Louis office. Robert P. Dodds, formerly sales engineer in the Albertson, L. I., office, has been appointed district representative at the San Diego office. Twelve years of aviation experience preceded Dodds' arrival at Vickers in 1958.

New distributor appointments

The Jesse W. Eakins Corp., Detroit, will represent Commercial Filters Corp. in Michigan.

John Henry Foster Co., St. Louis, and Womack Machine Supply Co., Houston, will represent Ortman-Miller Machine Co., Inc., in their territories.

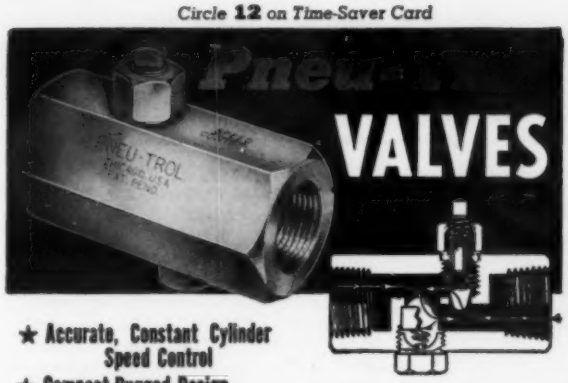
Controlomatic, Pittsburgh, is a new stocking distributor for valves by Republic Mfg. Co., Cleveland.

Jack Ogle & Co., Seattle and Portland, will distribute industrial tube and hose fittings and hydraulic accumulators for Parker-Hannifin Corporation.

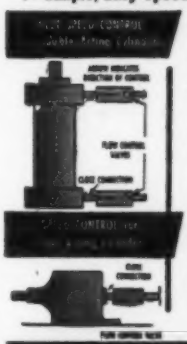
Air Devices, Inc., Houston, and Western Machinery Corp., Portland, have been named distributors in their areas for Wilkerson Corporation.

The Paul-Monroe Co., Bell Gardens, Calif., has been appointed sales agent in Southern California and Arizona by Perfex Corporation for the line of heat exchangers.

Circle **12** on *Time-Saver Card*



★ Accurate, Constant Cylinder Speed Control
★ Compact Rugged Design
★ Simple, Easy Speed Selection ★ For Air, Oil or Water Applications



Pneu-Trol Speed Control Valves, are widely used in hundreds of control applications because they combine in a short, compact body, a tapered fine thread needle for extremely accurate air or oil flow control and a floating retro ball check, which permits full flow in the opposite direction. Retro ball floats in most sensitive position to its seat, requiring only a slight differential pressure to fully open or close it.

Needle design permits maximum flow capacity in the controlled direction. Metal to metal needle and ball seats insure long trouble-free service. Simple, practical "O" gland structure eliminates troublesome leaking. Valve bodies machined from hex brass or aluminum for 2000 psi working pressures; steel and stainless steel for 5000 psi. Made in 5 female pipe sizes—⅛" to ¾". ATTRACTIVE PRICES . . . IMMEDIATE DELIVERY.

Write for illustrated circular and prices.

PNEU-TROL
A DIVISION OF **AUTO-PONENTS, INC.**
2919 Grant Street • Bellwood, (Chicago Suburb) Illinois

Circle **81** on *Time-Saver Card*

NEW! KEPNER **Kepsel**

The Check Valve that cuts costs of Design and Installation 75% and more!

- Leak Proof—At All Pressures
- Low Pressure Drop at Full Flow
- Eliminates All Threaded Connections
- Eliminates Expensive Machining

Small in size—big in capacity—simple to install—the KEPNER Kepsel Cartridge Type Check Valve is designed for positive performance. Eliminates expensive machining, finishing of fine, close tolerances, metal surfaces—dirt can't hurt it.

Write for complete technical data

*Patent Applied For

KEPNER PRODUCTS COMPANY
7721 West 59th Street Summit, Illinois

Circle **104** on *Time-Saver Card*

SAVE ON NEW & SURPLUS HYDRAULICS

NEW PALLEY HYDRAULICS

Here are two of our newly developed line of double action industrial Hydraulic Cylinders. These cylinders are designed to meet the most rigid requirements of industry. All are heavy duty steel construction. SAVE!

Type (A) is a heavy duty, press type cylinder with bores of 3", 5", 6" and 8" — thrust ranges up to 75 TONS at 3000 PSI.

Type (B) is an internal cap type cylinder with bores of 1-1/2", 2", 2-1/2", 3", 3-1/2" and 4". Has a thrust range of 2" to 48". Delivers up to 18,850 lbs. of thrust on 1500 PSI line pressure.

For COMPLETE LISTING of our tremendous ON-THE-SHELF stocks and prices ... Send for Cat. H-59.

3000 PSI HAND PUMP

Operates up to 3000 PSI. Has a built-in return flow check valve. Inlet port ½" AN, outlet 1/4" AN. No. HP-30 **Only 22.50**

1500 PSI Hydraulic HAND PUMP

Displaces 0.19 GPM at 30 cycles per min. Capacity 1.5 cu. in. per cycle. No. HP-3U **6.88**

NEW HEAVY DUTY SLIDING PISTON 4-WAY VALVE

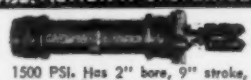
Available in Open or Closed Center. 3000 PSI type available with spring return or detents. 2000 PSI type has spring return to neutral. Specify type needed. Both have built-in adjustable relief valve. Maximum flow is 10 GPM. Order either 2000 or 3000 PSI type. SAVE at our LOW PRICES!

2000 PSI type $24.50
3000 PSI type $32.75

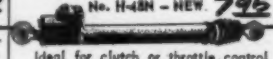
STRATO POWER HYD. PUMP

Delivers 10 gal. per minute at 1500 RPM at 3000 PSI. Pressure is adjustable from 2800 to 3800 PSI. A variable displacement, piston type. Displaces 1.694 cubic in. per revolution. **99.50**

DBL. ACTION HYD. CYLINDER



1500 PSI. Has 2" bore, 9" stroke, 7/8" shaft, 14-1/4" length. Approx. Gov't cost —$75
Cat. No. H-48U — Used **5.95**
No. H-48N — NEW **7.95**



Ideal for clutch or throttle control when used as a master & slave. Bore 5/8", stroke 4-1/8", shaft 7/16", length 9-5/8". Ports 1/4" tube. NEW. Cat. No. H-60 **3.75**

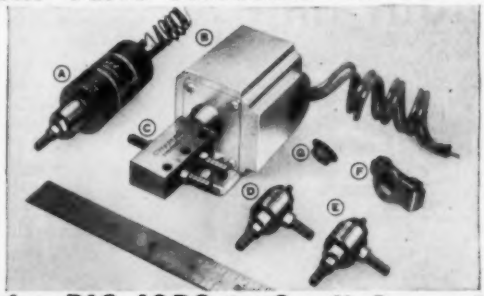
NOTE: We stock the largest ON-THE-SHELF stock of Hydraulic Equip. in the World. Stocks include Hydraulic Pumps, Valves, Cylinders, Motors, Hose and fittings of all kinds. Write for Catalog section H-59 and SAVE!

Pay by M.O. or Check. P.O.s accepted from D&B firms rated P2½ or better. 1/2 deposit with C.O.D.s. Prices F.O.B. Los Angeles Whse.

palley's 2263 E. Vernon Ave. Dept. AH-79 Los Angeles 58, Calif.

Circle **32** on *Time-Saver Card*

NEW MIGHTY MINIATURE
Air Valve Solenoids and Valves



for BIG JOBS in Small Spaces!

Ⓐ **D.C. AIR VALVE SOLENOID** for 12 or 24-volt operation
Ⓑ **A.C. AIR VALVE SOLENOID** for 115 volt operation (other voltages available)
Ⓒ **4-WAY AIR VALVE (MAV-4)** 5.3 CFM at 50 psi
Ⓓ **3-WAY AIR VALVE (MAV-3)** 4.5 CFM at 50 psi
Ⓔ **2-WAY AIR VALVE** 4.5 CFM at 50 psi
Ⓕ **CAM FOLLOWER HEAD** for automatic valve cycling
Ⓖ **MANUAL PUSH BUTTON** for fingertip valve operation

Clippard Minimatics TRADE MARK

Write, NOW for NEW BULLETIN No. 4-59

***Clippard* INSTRUMENT LABORATORY, INC.**
7386 Colerain Rd., Cincinnati 39, O. • Phone: JAckson 1-4261
Manufacturers of Miniature Pneumatic Devices, R.F. Coils, Electronic Equipment

Circle **127** on Time-Saver Card

"A.N.D." and "M.S." HYDRAULIC CONTOUR CUTTERS in stock

A.N.D. 10050 internal

Economy series; integral plain pilot

Turret lathe and drill press series; integral carbide reamer pilot

Heavy duty series; replaceable carbide reamer or plain pilot, carbide and HSS

MS33656, MS33657, MS33514, and MS33515 O.D. flat form tools

Carbide tipped High speed steel

MS33514 internal

Solid carbide, carbide tipped, high speed steel models

MS16142 internal S.A.E.

Carbide tipped; plain or reamer pilot

Write for sizes and prices.

SONNET Tool and Mfg. Co.
580 North Prairie Avenue, Hawthorne, California

beyond normal endurance...

GLASSCO **bourdon helix**
PRESSURE GAUGES PERFORM WITH ACCURACY AND RELIABILITY **BEYOND** ALL PUBLISHED MIL SPECS.

Glassco **Instrument Company**
660 SOUTH FAIR OAKS AVENUE
PASADENA 2, CALIFORNIA

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THE MARKET PLACE

When replying to a box number in the Market Place, address your letter to Applied Hydraulics & Pneumatics, 812 Huron Road, Cleveland 15, Ohio. Attention: Box No.

WANTS NEW LINES

Stocking Distributor specializing in Pneumatic products would like to add suitable lines on exclusive basis in North and South Carolina. Write Box 7159, APPLIED HYDRAULICS & PNEUMATICS.

LINES WANTED

Manufacturers' agent wants lines of Fluid Power Components and accessory items. Territory New England and East Coast. What have you to offer? Will consider all or part of territory. Write Box 7259, APPLIED HYDRAULICS & PNEUMATICS.

SALES ENGINEER WANTED

A substantial and expanding Middle-West manufacturer of hydraulic pumps, valves and allied products needs a specialized sales engineer. This man will head up the activity in pumps, etc., in high pressure, large capacity applications.

We are a close-knit congenial group. Location is a medium-size city with ready access to excellent out-of-door activities. Our people have careers, not jobs. We are seeking a man who would intend that this shall be his last move.

The man selected will be in the 30-40 year age bracket. His past experience must include a substantial background in complicated circuits utilizing high pressure equipment.

The man we seek probably now has earnings in the five-figure bracket. He is accustomed to dealing with top-level engineering and executive personnel. He is interested in a change in connections because his present progress is blocked through no fault of his own. We offer that man an outstanding opportunity.

Everyone in our organization knows this opportunity is available. In your reply please give us educational background, age, marital status, previous and present employment, past and current earnings. Enclose a late snapshot. Everything submitted held absolutely confidential. Write Box 7359, APPLIED HYDRAULICS & PNEUMATICS.

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Pilot-Sales Engineer wanted Chicago Area. Commercial or ATR Multi-engine ratings required for light twin. Unusual opportunity training for Sales Engineering Manager with young progressive company. Knowledge of Pneumatic and Hydraulic Controls an asset. Reply Box 7459, APPLIED HYDRAULICS & PNEUMATICS.

ENGINEERS (M.E.) & SALES ENGINEERS

Expanding, well-established NYC area mfr. of hydraulic/pneumatic controls and valves offers unusual opportunities to topnotch design and R&D men. Also desires experienced sales engineers to call on aircraft and missiles industries. Salaries open. Write Box 7559, APPLIED HYDRAULICS & PNEUMATICS.

AIR CONTROL VALVE LINE AVAILABLE

Nationally known concern is seeking qualified distributors for a complete line of Air Control Valves. Hand, foot, electric, and air operated; 2-, 3- and 4-way; ⅜" through 1" pipe sizes. Meet J.I.C. recommendations. Many key areas available. Inquiries held in strict confidence. Write Box 7659, APPLIED HYDRAULICS & PNEUMATICS.

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Fall Wiper Ring SPRING LOADED

The Fall "CJ"* Wiper-Scraper Ring is Spring-Loaded causing Squeeze-Grip Action on the O.D. of the piston rod during entire cycle. This patented feature maintains a uniform, continuous pressure on the wiping edge of the ring at all times, stopping any buildup of foreign matter between the ring and the rod.

It automatically takes up wear, maintaining NEW RING PERFORMANCE. Available in diameters ½" through 13" for any commercial use. AN and MS numbers in use by the Military and Aviation industry since 1944. Manufactured in accordance with MIL-S-5049. (*Closed Joint)

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1820 N. 12th St. Toledo 1, Ohio
Est. 1935

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BUILD ON...

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HYDRAULIC EXPERIENCE:

GEAR PUMPS and FLUID MOTORS

129 hydraulic pump and electric motor combinations are available off-the-shelf, for most applications. Outside this broad range, specific customer requirements can be met by drawing on Eastern's vast design resources.

All standard Eastern gear pumps are low in cost, light in weight, compact and reliable. Unique design features and very close tolerances enable each unit to achieve high volumetric efficiencies.

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1200 series – up to 1.6 G.P.M. – pressures to 800 P.S.I.

100 series – up to 5 G.P.M. – pressures to 1500 P.S.I.

700 series – up to 9.8 G.P.M. – pressures to 1500 P.S.I.

In addition to these pumps, Eastern also produces a wide range of fluid motors, each capable of delivering a constant torque over a very wide speed range. They provide up to 14.5 ft. lbs. of torque at 1750 R.P.M. For full information on any one of these pumps, pump-and-motor combinations, or fluid motors, consult the Eastern sales engineer – or write for bulletin 810-N.

Eastern designs and builds

positive displacement pumps • gear pumps • centrifugal pumps

EASTERN INDUSTRIES INCORPORATED

100 SKIFF STREET
HAMDEN 14, CONN.

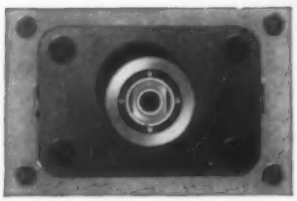
EASTERN INDUSTRIES PUMP DIVISION

Circle **43** on Time-Saver Card

YOUR BONUS from Pathon

HYDRAULIC CYLINDERS

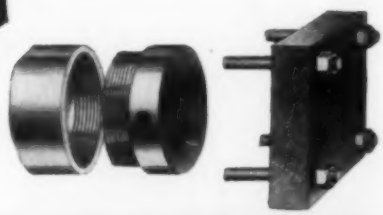
For the Designer



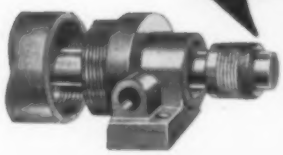
Pathon's compact design saves valuable space, makes your designing job easier, and gives your equipment that modern, rugged look.

For the User

Pathon's screw thread head design gives you up to 40% more strength than most tie-rod cylinders. This increased strength means less maintenance, and longer life.



For the Maintenance Man



Rod packing and bearing is externally replacable and any part can be replaced without complete disassembly and the resulting "basket full of parts".

FOR YOU

Let us give you a "Rod Column Effect" calculator. From this easy-to-use slide rule obtain optimum rod diameter for a given load and stroke.

Write for Calculator and Bulletin No. 22-A

Pathon MANUFACTURING COMPANY

8-59 **3823 PACIFIC AVE. • CINCINNATI 12, OHIO**

FLUID OPERATED AND CONTROL EQUIPMENT

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NAME

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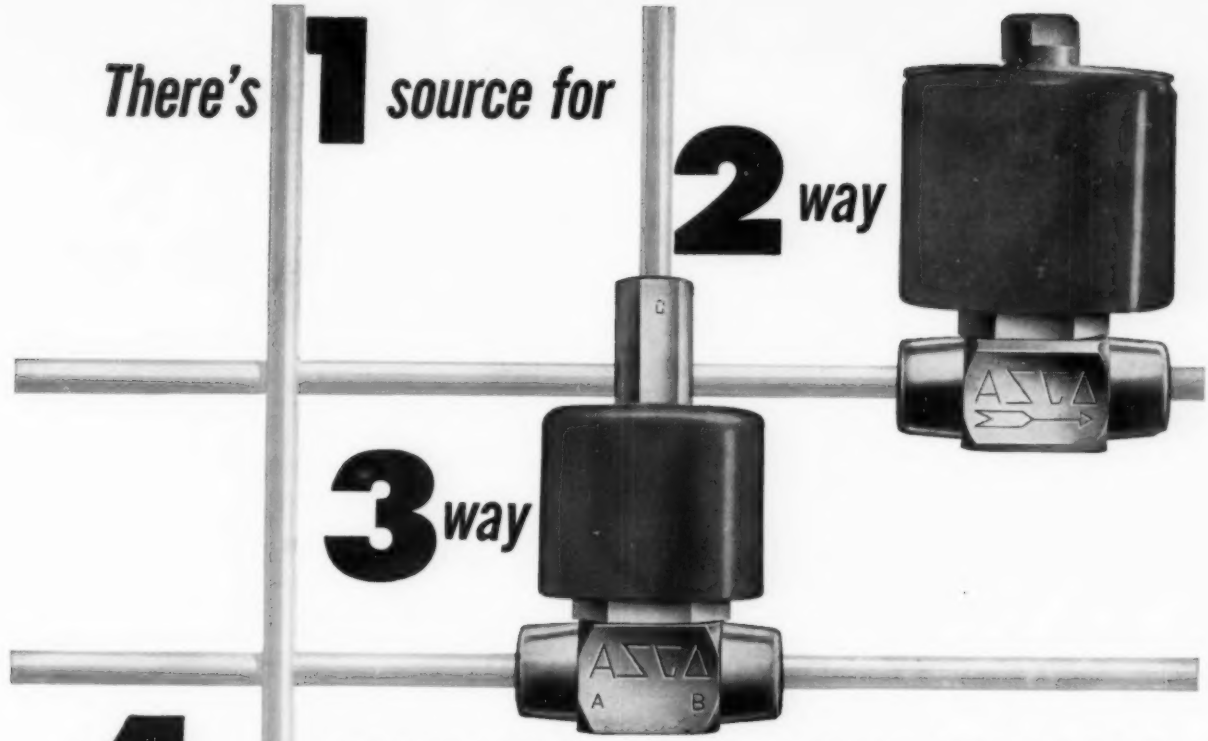

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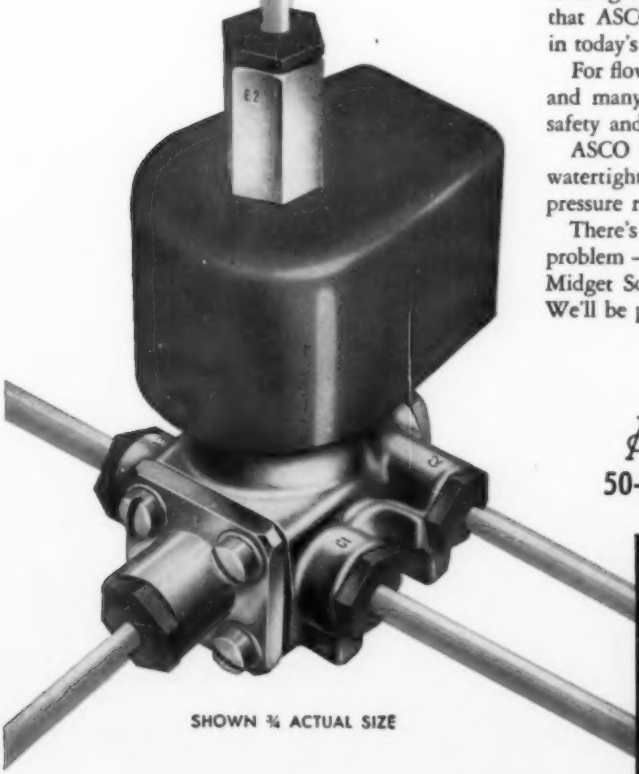

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